

INDIVIDUAL DIFFERENCES IN COGNITION AND AFFECTS IN THE ERA OF PANDEMIC AND MACHINE LEARNING

EDITED BY: Yang Jiang, Renlai Zhou, Vasileios Maroulas, Xiaopeng Zhao
and Andrea Vranic

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INDIVIDUAL DIFFERENCES IN COGNITION AND AFFECTS IN THE ERA OF PANDEMIC AND MACHINE LEARNING

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Table of Contents

- 05** *Editorial: Individual Differences in Cognition and Affects in the Era of Pandemic and Machine Learning*
Andrea Vranic, Yang Jiang and Xiaopeng Zhao
- 08** *Reduction of COVID-19 Anxiety Levels Through Relaxation Techniques: A Study Carried Out in Northern Spain on a Sample of Young University Students*
Naiara Ozamiz-Etxebarria, María Dosil Santamaría, Amaia Eiguren Munitis and Maitane Picaza Gorrotxategi
- 14** *Corrigendum: Reduction of COVID-19 Anxiety Levels Through Relaxation Techniques: A Study Carried Out in Northern Spain on a Sample of Young University Students*
Naiara Ozamiz-Etxebarria, María Dosil Santamaría, Amaia Eiguren Munitis and Maitane Picaza Gorrotxategi
- 15** *Fear of COVID-19, Stress, and Anxiety in University Undergraduate Students: A Predictive Model for Depression*
Antonio J. Rodríguez-Hidalgo, Yisela Pantaleón, Irene Dios and Daniel Falla
- 24** *Effectiveness of Expressive Writing in the Reduction of Psychological Distress During the COVID-19 Pandemic: A Randomized Controlled Trial*
Maša Vukčević Marković, Jovana Bjekić and Stefan Priebe
- 35** *The Influence of Personality, Resilience, and Alexithymia on Mental Health During COVID-19 Pandemic*
Sofia Adelaide Osimo, Marilena Aiello, Claudio Gentili, Silvio Ionta and Cinzia Cecchetto
- 45** *Individual Differences Facing the COVID-19 Pandemic: The Role of Age, Gender, Personality, and Positive Psychology*
Gloria Bernabe-Valero, David Melero-Fuentes, Irani I. De Lima Argimon and Maria Gerbino
- 57** *The Relationship Between Quarantine Length and Negative Affect During the COVID-19 Epidemic Among the General Population in China: The Roles of Negative Cognition and Protective Factors*
Lulu Hou, Fangfang Long, Yao Meng, Xiaorong Cheng, Weiwei Zhang and Renlai Zhou
- 69** *Trust in Science, Perceived Vulnerability to Disease, and Adherence to Pharmacological and Non-pharmacological COVID-19 Recommendations*
Ivana Hromatko, Mirjana Tonković and Andrea Vranic
- 78** *Boldness Personality Traits Are Associated With Reduced Risk Perceptions and Adoption of Protective Behaviors During the First COVID-19 Outbreak*
Tiago O. Paiva, Natália Cruz-Martins, Rita Pasion, Pedro R. Almeida and Fernando Barbosa
- 85** *Anxiety and Social Support as Predictors of Student Academic Motivation During the COVID-19*
Ana Camacho, Nadine Correia, Sonia Zaccoletti and João R. Daniel

- 96** *Who Believes in COVID-19 Conspiracy Theories in Croatia? Prevalence and Predictors of Conspiracy Beliefs*
Mirjana Tonković, Francesca Dumančić, Margareta Jelić and
Dinka Čorkalo Biruški
- 109** *One Hundred and Sixty-One Days in the Life of the Homopandemicus in Serbia: The Contribution of Information Credibility and Alertness in Predicting Engagement in Protective Behaviors*
Žan Lep, Sandra Ilić, Predrag Teovanović, Kaja Hacin Beyazoglu and
Kaja Damnjanović
- 131** *Analytic Thinking and Political Orientation in the Corona Crisis*
Marina Maglić, Tomislav Pavlović and Renata Franc
- 154** *Autogenic Training Improves the Subjective Perception of Physical and Psychological Health and of Interpersonal Relational Abilities: An Electronic Field Survey During the COVID-19 Crisis in Spain*
Luis de Rivera, Naiara Ozamiz-Etxebarria, María Dosil-Santamaría and
Leonor de Rivera-Monterrey
- 161** *The Relationship Between Perceived Stress and Subjective Cognitive Decline During the COVID-19 Epidemic*
Anja Podlesek, Luka Komidar and Voyko Kavcic
- 176** *The Moderation Effects of Comparative Thinking Between Gratitude and Negative Affect During the COVID-19 Outbreak*
Gloria Bernabe-Valero, José Salvador Blasco-Magraner,
Remedios Aguilar-Moya and Carmen Moret-Tatay
- 185** *Mental Health in Affectionate, Antagonistic, and Ambivalent Relationships During the COVID-19 Pandemic: A Latent Profile Analysis*
Jasmina Mehulić and Željka Kamenov



Editorial: Individual Differences in Cognition and Affects in the Era of Pandemic and Machine Learning

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Editorial on the Research Topic

Individual Differences in Cognition and Affects in the Era of Pandemic and Machine Learning

At the launch of this issue, then newly discovered COVID-19 seemed to be faltering, and the collection of papers gathered in this publication was bound to be both a reminder and a relatively final display of domains and aspects of human functioning that were somehow affected by the corona crisis. Meanwhile, the health situation in the world has shown us the full breadth of the impact that the coronavirus has left or still leaves in almost all fields of human behavior. Overall, bibliographic mapping shows that most of the papers, framed within the scientific study of coronavirus and its societal impact, were in the field of medicine and psychology (Gul et al., 2020). Mirroring the solidarity and unifying efforts to overcome the crisis, collaborative research and multiple authorships prevail. This exact pattern can be seen in the collection of 16 collaborative papers gathered within this Research Topic.

The Topic reported some surprising findings as well. For instance, counter to most people's initial expectation, young people suffered significantly more psychological stress than older people during the pandemic. Older adults who are more vulnerable to COVID-19 showed strong resilience around the world. Notably, the research on predictive model of stress and anxiety for depression in undergraduate students by Rodríguez-Hidalgo et al. has been read more than 113,000 times up to the point of the publication of this Editorial. Our readers are from all continents and in humanities, social, science, and health domains. Here, we summarize what we have learned from this Research Topic, in terms of differential psychological and emotional responses of young and older adults, as well as from emerging techniques aimed at coping with nowadays everyday pandemic.

As in the case of other health crises in the human history, our research collection has placed an emphasis on the effects of this pandemic on our emotional and cognitive behaviors, as well as attempts to prevent or mitigate its destructive effects. Indeed, most of the collected papers revealed the affective side of living with the pandemic. These studies cover topics of anxiety (Camacho et al.; Rodríguez-Hidalgo et al.), mental health (Osimo et al.; Mehulić and Kamenov), and positive (e.g., gratitude, purpose in life) and negative affects (Bernabe-Valero, Melero-Fuentes et al.; Hou et al.) during the COVID-19 outbreak. Taking a more differential approach, papers dealing with the socio-cognitive factors related to the COVID-19 crisis build the next larger group of the collected articles (Bernabe-Valero, Blasco-Magraner et al.; Maglić et al.; Podlesek et al.; Tonković et al.). The third group includes papers dealing with preventive and protective behaviors, such as adherence to epidemiological recommendations (Lep et al.; Paiva et al.; Hromatko et al.). A

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final group of studies conferred deals with the way of mitigating psychological distress (de Rivera et al.; Ozamiz-Etxebarria et al.; Vukičević Marković et al.) during the coronavirus crisis. In the following paragraphs we have grouped these studies according to overarching topic, with their main findings summarized.

ANXIETY AND MENTAL HEALTH

Studies centered around the topic of anxiety and mental health prove that anxiety is found almost universally to be the strongest behavioral feature of life in the COVID crisis. Not surprisingly it sets the main framework for counteracting the negative consequences of the crisis. The following articles show that the key to resilience are supportive and affectionate relationships in different life contexts, gratitude, and empowerment of general coping strategies:

- Fear of COVID-19, Stress, and Anxiety in University Undergraduate Students: A Predictive Model for Depression (Rodríguez-Hidalgo et al.)
- Anxiety and Social Support as Predictors of Student Academic Motivation During the COVID-19 (Camacho et al.)
- The Influence of Personality, Resilience, and Alexithymia on Mental Health During COVID-19 Pandemic (Osimo et al.)
- Mental Health in Affectionate, Antagonistic, and Ambivalent Relationships During the COVID-19 Pandemic: A Latent Profile Analysis (Mehulić and Kamenov)
- The Relationship Between Quarantine Length and Negative Affect During the COVID-19 Epidemic Among the General Population in China: The Roles of Negative Cognition and Protective Factors (Hou et al.)
- The Moderation Effects of Comparative Thinking Between Gratitude and Negative Affect During the COVID-19 Outbreak (Bernabe-Valero, Melero-Fuentes et al.).

DIFFERENTIAL SOCIO-COGNITIVE FACTORS IN COVID CRISIS

It seems that the consequences of living with anxiety will have a differential effect on different people and it is important to note that a mild subjective cognitive decline may be experienced by some individuals during the epidemic. Individuals characterized by open-minded thinking and general trust in science will be more likely to avoid physical contact, maintain physical hygiene, and support COVID-19 restrictive mitigation policies. These recommendations will also be more appreciated by people who feel more grateful and have a stronger sense of purpose in life, suggesting that these features should be fostered in interventions designed to encourage public coping with the pandemic. The following studies deals with these issues:

- Analytic Thinking and Political Orientation in the Corona Crisis (Maglić et al.)
- Who Believes in COVID-19 Conspiracy Theories in Croatia? Prevalence and Predictors of Conspiracy Beliefs (Tonković et al.)

- The Relationship Between Perceived Stress and Subjective Cognitive Decline During the COVID-19 Epidemic (Podlesek et al.)
- Individual Differences Facing the COVID-19 Pandemic: The Role of Age, Gender, Personality, and Positive Psychology (Bernabe-Valero, Blasco-Magraner et al.).

ADHERANCE TO RECOMMENDATIONS

While individual differences in cognitive and affective responses are important, a coherent and credible communication in all stages of the struggling with pandemic is crucial in forming solidarity with the recommendations and social trust. Still public strategy must keep in mind the individual differences and accommodate the knowledge of these differences in public health strategies when communicating the importance of adherence to recommendations. Psychological mechanisms underlying adherence to pharmacological (vaccination) vs. non-pharmacological measures differ, which should also be considered when planning communication strategy. These are the studies dealing with the above topics:

- One Hundred and Sixty-One Days in the Life of the Homopandemicus in Serbia: The Contribution of Information Credibility and Alertness in Predicting Engagement in Protective Behaviors (Lep et al.)
- Boldness Personality Traits Are Associated With Reduced Risk Perceptions and Adoption of Protective Behaviors During the First COVID-19 Outbreak (Paiva et al.)
- Trust in Science, Perceived Vulnerability to Disease, and Adherence to Pharmacological and Non-pharmacological COVID-19 Recommendations (Hromatko et al.).

MITIGATION OF NEGATIVE CONSEQUENCES

Consistent with the universality of anxiety as a key behavioral descriptor of life with a pandemic, studies on the mitigation of pandemic's negative consequences mostly deal with the anxiety mitigation. While some techniques prove to be effective (such as autogenic training and relaxation techniques), it is advised to avoid some self-guided techniques (such as expressive writing) in the context of the COVID 19 pandemic—as suggested by the following studies:

- Autogenic Training Improves the Subjective Perception of Physical and Psychological Health and of Interpersonal Relational Abilities: An Electronic Field Survey During the COVID-19 Crisis in Spain (de Rivera et al.)
- Reduction of COVID-19 Anxiety Levels Through Relaxation Techniques: A Study Carried Out in Northern Spain on a Sample of Young University Students (Ozamiz-Etxebarria et al.)
- Effectiveness of Expressive Writing in the Reduction of Psychological Distress During the COVID-19 Pandemic: A Randomized Controlled Trial (Vukičević Marković et al.).

This Research Collection offers high-quality theoretical insights and empirical findings covering a range of behavioral domains intertwined into our everyday life in the context of pandemic. In a way, the technical details of this issue also speak of life during the pandemic, its immediate effects in terms of our emotional and cognitive experience and behaviors, as well as our ways of coping with its consequences. The pandemic is overall and omnipresent. Fifty-seven authors from 12 countries (Brazil, China, Croatia, Ecuador, Italy, Portugal, UK, United States, Serbia, Slovenia, Spain, Switzerland) and three continents testified about the efforts made world-wide to better understand its impact and mobilize inter- and intra-individual resources in combating its negative consequences.

We have found commonalities of psychological responses of fear, anxiety, conspiracy, resiliency, and support across countries and cultures. We have also seen strong individual and group differences responding to COVID-19 related stress due to age, gender, and culture. This Research Collection provides examples of the many ways in which evolutionary principles can help advance psychological and behavioral science applied in a pandemic context. The Topic provides scientific evidence of effective coping strategies to protect from stress and negative emotions, such as:

- Build trust in science and lower the sense of political helplessness
- Increase optimism, cognition, uncertainty tolerance, and social support
- Mindfulness, relaxation, and writing to reduce stress.

This Research Topic was envisioned as an evidence-based reminder of the times of crisis caused by the new and then little-known coronavirus. By clearly identifying areas of research important for our coping with the pandemic and its effects, this Research Topic has outgrown its primary purpose. It can now be viewed as a tool for generating new valuable research ideas, consolidating the existing findings, and testing future treatment strategies.

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REFERENCES

Gul, S., Rehman, S. U., Ashiq, M., and Khattak, A. (2020). Mapping the scientific literature on COVID-19 and mental health, *Psychiatr. Danub.* 32, 463–471. doi: 10.24869/psyd.2020.463

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Reduction of COVID-19 Anxiety Levels Through Relaxation Techniques: A Study Carried Out in Northern Spain on a Sample of Young University Students

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Since March 14, 2020, Spain has been in a state of alarm due to the crisis created by the outbreak of COVID-19. This measure has led to strict levels of lockdown. This situation has led to an increase in anxiety levels among the younger population. For this reason, an intervention was carried out on university voluntary participants in order to help lower their anxiety levels. Specifically, a telematic workshop was implemented to teach emotional literacy and relaxation techniques combined with the practice of the techniques in an autonomous manner. Anxiety measurements were taken before and after the workshop using the Generalized Anxiety Disorder – 7 (GAD-7) scale. The results show that Jacobson's progressive relaxation techniques, Schultz's autogenic training, abdominal relaxations, and visualizations are effective in lowering the anxiety levels of university students as an alternative to pharmacotherapy.

Keywords: anxiety, relaxation techniques, university students, telematic psychoeducation, COVID-19

INTRODUCTION

The Spanish State has been in a state of alert since March 14, 2020 due to the COVID-19 pandemic. As demonstrated in a recent investigation, the general population is experiencing situations of anxiety, and in some groups and individuals, the level of anxiety has increased due to lockdown and uncertainty and due to the de-escalation situation we are experiencing (Hao et al., 2020).

Contrary to initial estimates, this historical and unprecedented situation for the younger population is affecting them psychologically more than the adult population (Taylor et al., 2008). In particular, students are proving to be one of the most vulnerable populations due to the age of near adolescence when peers become more important (Gallego et al., 2011). The World Health Organization (World Health Organization (WHO), 2018) understands that adolescence occurs between the ages of 10 and 19 years in its two phases, early adolescence (10–14 years) and late adolescence (15–19 years). The situation is aggravated by the stress to which they are subjected by the studies themselves linked to the new methodologies of receiving classes telematically and information and communication technologies (ICTs) (Jung et al., 2012; Rogero-García, 2020).

For all these reasons, the students refer to living insomnia in the face of changes in routine and stress that this new situation may be causing them, in addition to experiencing high levels of anxiety characterized by feelings of catastrophe or imminent danger, feelings of risk, tension, insecurity, and suffering.

Against this background, several studies are showing that telematic psychotherapy can be of great help to people who are suffering psychologically with this pandemic (Macias and Valero, 2018). In the Basque Country, psychological services were set up in the Basque Health Service (Osakidetza) from the moment that COVID-19 cases began to increase. However, not all the population has access to this resource; thus, it is important to provide psychological resources by other means, such as guidelines for dealing with anxiety in the face of the pandemic.

According to the Anxiety Disorders Association of America and the Spanish Society for the Study of Anxiety and Stress, there are different methods for dealing with anxiety. Non-pharmacological interventions, such as relaxation, yoga, problem-solving techniques, biofeedback, psychotherapy, and cognitive-behavioral techniques, are the most effective in combating anxiety (Bushell, 1998; Vaccaro et al., 2019; Armat et al., 2020; Gadea et al., 2020).

There are many physical and psychological benefits that can be achieved through the practice of relaxation techniques (Smith et al., 2018):

- They help to create feelings of well-being and tranquility as well as help to care for sleep hygiene and combat insomnia.
- They strengthen the immune system, help to lower anxiety, and increase the ability to cope with different situations that can create stress.
- They decrease physiological symptoms that can occur with anxiety, such as decreased heartbeat and breathing and increased ability to concentrate and memory.
- They increase energy level, positive thoughts, and creativity and help to create a positive self-image.

In summary, through relaxation, positive effects can be achieved on three different levels. Firstly, on a physiological level, muscle tension and breathing frequency are reduced, and heart rate is lowered. Secondly, on a behavioral level, controlled and calm movements and hypoactivity are achieved. Finally, on a cognitive level, there are thoughts of tranquility, well-being, images of calm situations, and perception of sweet feelings (Rasid and Parish, 1998).

According to Burgos Varo et al. (2006), the most effective relaxation techniques to reduce the levels of autonomic activation and the unpleasant experience of anxiety by improving sleep and other stress-related symptoms are Jacobson's progressive relaxation (Bushell, 1998), Schultz autogenic training (Schultz, 1969), breathing techniques, and visualizations as explained below.

Jacobson's progressive muscle relaxation is a technique in which the muscles are first tensed and then relaxed by different muscle groups throughout the body. The main objective is to recognize the difference between a state of muscle tension and a state of muscle relaxation. In this way, a state of muscular

relaxation is achieved that progressively becomes generalized to the whole body (Mármol, 2013; Toro, 2019).

In Schultz's autogenic training, there are six exercises that must be learned progressively. These exercises consist of the passive concentration of the body's own sensations. Through some simple self-instructions, the person will be able to get his extremities first, and the rest of his body later, to relax through the sensations of heat and weight. The regulation of the heart or breathing frequency must be the result of a process that must occur automatically, after thinking that the heart beats calmly or that breathing is relaxed. Finally, the imagination of coolness in the head should help to have feelings of well-being and also clarity (Schultz, 1969).

Abdominal or diaphragmatic breathing is a breathing technique that consists of taking advantage of the empty space left by the abdomen as it expands forward to widen the lungs, since the diaphragm tends to go downward in such expansion (Chen et al., 2017; Rygiel, 2019). This method is based on the influence of the physiological component of emotions. It lowers blood pressure and heart rate and results in increased oxygenation of the cells, improved metabolism, and improved circulation through abdominal breathing. In addition to burning body fat, it strengthens lung health. Tiredness and poor ventilation can lead to energy deficits and depression; thus, practicing abdominal breathing also improves mood. It is a relaxation that provides multiple benefits: it provides more energy, improves digestion and skin appearance, helps control emotions and reduce fatigue, and improves anxiety symptoms.

Finally, visualization is a technique by which stress and anxiety can be reduced to bring the body and mind into a deep state of relaxation. Through this technique, a series of imaginary images is related to positive emotions. In this way, negative thoughts are transformed to reach a state of optimal well-being (López et al., 2019).

The aim of the present study is to evaluate the levels of anxiety in university students in the face of the COVID-19 pandemic crisis before and after telematic teaching and practice of different relaxation techniques. Their anxiety levels are expected to drop considerably.

MATERIALS AND METHODS

Participants

In the first sample, 48 young people participated; four were eliminated from the total sample because they did not carry out the relaxations and, therefore, did not comply with the methodological criteria of this research.

Among a total of 44 participants, 7 ($n = 15.9\%$) were men, and 37 ($n = 84.1\%$) were women. Their average age was 19.5 years with an age range of 19–21 years. All of them were second year university students of the Degree in Child Education of the Faculty of Education of the Public University of the Basque Country (Leioa, Spain) to work as teachers in the age range of 0–6 years old. The criteria for inclusion were to take the subject Developmental and Learning Difficulties in the grade of Child Education, to commit to participate in the learning of

relaxation techniques voluntarily, and to have a computer to be able to receive the training telematically. Regarding the criteria for exclusion, it was recommended that people who had any illness that prevented them from performing relaxation should not participate in the study.

The students participated voluntarily, received information about the research procedure, and gave their consent before participating in the study. Therefore, the procedure followed is approved by the Ethics Committee in accordance with the Declaration of Helsinki of the World Medical Association.

Measures and Instruments

A brief introduction of socio-personal data and data of interest to this study was made before starting with the validated scale. Among the socio-personal data, age and sex were collected.

The scale administered was the scale for generalized anxiety disorder. The original version is the Generalized Anxiety Disorder – 7 (GAD-7) scale (Spitzer et al., 2006). It is an instrument created to screen for generalized anxiety disorder. This instrument is composed of seven Likert-type response items from 0 to 3 that include the symptoms and disability associated with the disorder. For its correction, a total score is obtained from the sum of scores of all items, which can range from 0 to 21. For the Spanish version that was validated with 212 people (García-Campayo et al., 2010), a Cronbach's alpha coefficient of 0.93 was obtained. In the present research, Cronbach's alpha was 0.80 in the pre-test and 0.74 in the post-test.

Procedure

The first step was to get permission from the university's Ethics Committee (UPV) to carry out this research.

The project was carried out at the University of the Basque Country (UPV/EHU) located in the north of Spain and with a world ranking of the 500 best universities. The students of the Infant Education degree participated in the project, specifically the students of the subject of Developmental and Learning Difficulties, which is taught in the second quarter of the second year (2020/2021).

This is a design without a comparison group, since the effectiveness of the relaxation techniques has been compared before performing and explaining the relaxation techniques and after the intervention.

Workshop Procedure

In the first week of April, students were informed about the study. Those who decided to participate voluntarily completed the pre-tests using the Google Forms platform. The questionnaires completed by the students were anonymous and had to include a code to identify the relationship between the questionnaires completed before and after the workshop.

The training program consisted of four sessions led by a health psychologist with extensive experience in relaxation techniques (Lether, 1996; Lsalt and Kerr, 1997; Solomen and Aaron, 2015; Abuín, 2016). The first session focused on awareness of emotions and anxiety symptoms. The second session focused on learning relaxation techniques (Jacobson's progressive relaxation, Schultz's autogenic training, abdominal

TABLE 1 | Organization of the sessions and their systematization.

Telematic session	Objectives	Contents
1. Emotional education	To study in depth the concept of emotion and anxiety	Define emotions and their physiological, cognitive, and behavioral components Define anxiety and its disorders
2. Learning about relaxation techniques	To learn different relaxation techniques and their benefits	Jacobson's progressive relaxation Schultz's autogenic training Abdominal breathing Visualization techniques
3. Sharing first experiences of relaxation practice and understanding the need to practice such relaxation	To identify the most effective technique for each student and reading the article	Each student shared experiences of the techniques that helped them most An article was read that referred to the importance of learning these techniques (Justo, 2008)
4. Sharing of different experiences and appreciation of relaxation techniques	To share and assess techniques	A discussion group was held to share experiences about the practices they had carried out

breathing, and visualization techniques). They were also advised to practice the different techniques and then choose the most appropriate one to lower their anxiety. The third session focused on learning the importance of practicing these techniques, and they shared experiences choosing the most appropriate technique for each one. After that, they practiced the chosen technique individually for 20 min for 2 weeks in their homes. The fourth session focused on the assessment of the techniques practiced by means of a group discussion (Table 1). All the sessions were carried out using the Blackboard Collaborate telematics program. The psychologist made an individualized follow-up of all the participants to make sure that they attended all the training sessions and performed the relaxation techniques. Once the workshop was completed, the anxiety measurements were taken again.

Data Analysis

The data extracted from the Google Forms questionnaire in Excel format were imported into the SPSS v.25 statistical program for further analysis. With the data obtained, descriptive analyses of the sample were carried out both on the socio-demographic data and on the differences between the pre- and post-relaxation technique tests. We categorized them into two groups, taking into account the mean of the total scale plus one standard deviation, so that all participants who were below that score were considered as not symptomatic (categorized with 1) and those who showed higher scores were considered as symptomatic (categorized with 2). The significant differences for these related samples were then analyzed using the non-parametric tests (taking into account the Shapiro–Wilk normality tests).

RESULTS

Among the relaxation techniques, 43.2% ($n = 19$) performed Jacobson's relaxation techniques, 36.4% ($n = 16$) abdominal breathing techniques, 11.4% ($n = 5$) Schultz's autogenic training,

TABLE 2 | Descriptive data in the pre- and post-anxiety tests (GAD-7) categorized.

	Pre	Post
N	44	44
M	1.5	1.3
DT	0.50	0.45
Minimum	1.00	1.00
Maximum	2.00	2.00

Scores above one indicate anxiety.

and 9.1% ($n = 4$) visualization. There was no significant difference in reducing anxiety levels according to the relaxation techniques that had been chosen.

As can be seen in **Table 2**, the mean anxiety measured with the GAD-7 scale is higher before relaxation techniques. In addition, a mean of more than 1 is observed at both times.

Pre- and Post-test Anxiety Frequencies

Overall, 45.5% ($n = 20$) of the university students indicated that they felt anxiety during these moments of confinement due to the COVID-19, and 54.5% ($n = 24$) did not feel anxiety. Likewise, once the relaxation techniques were performed and again evaluated with the same scale, anxiety seemed to decrease considerably, with 72.7% ($n = 32$) not feeling anxiety compared with 27.3% ($n = 12$) who indicated continuing with anxiety. Therefore, after the intervention, there was an improvement in the average anxiety levels of the participants.

Significant Differences Between Anxiety According to Sex

The data show statistically significant differences between girls ($Z = -2.60, p < 0.009, \eta^2 = 0.12$) and boys ($Z = -1.15, p < 0.251, \eta^2 = 0.11$) in the sample at the first sample collection (before relaxation techniques), with an intermediate effect size. The girls in the pre-test showed higher average mean values (23.8) than the boys (15.64).

DISCUSSION

After half a month of lockdown, the students began to show symptoms of anxiety due to the stress created by the lockdown itself (Qiu et al., 2020) and due to the stress of the end of the school year (Hernández-Pozo et al., 2008) (2019–2020). In addition to these factors, there is the stress of the new methodologies for teaching classes via telematics where ICTs prevail. Faced with this situation, the teaching staff decided to carry out an intervention with a group that had especially expressed high levels of anxiety.

In the present study, while the majority of the members of the groups have been women (84.1%), let us remember that the university population is currently composed mainly of women, and that the degree of Child Education is very feminized (Marquez-Domínguez et al., 2018).

Several studies have shown that alternatives to pharmacotherapy are effective in lowering anxiety levels

(Aritzeta et al., 2017). Likewise, relaxation training, together with cognitive-behavioral techniques, is one of the most widely used procedures to reduce the symptoms of anxiety. The students in the present study received positively the possibility of practicing different relaxation techniques to lower their anxiety levels. Most of the students practiced Jacobson's progressive relaxation (43.2%), followed by abdominal relaxation (36.4%), Schultz's autogenic training (11.4%), and relaxation techniques through visualization (9%).

Jacobson's technique was the most practiced because it is a simple technique to reach states of relaxation due to the awareness of bodily sensations of tension and distension. Likewise, Schultz's autogenic training is one of the most effective relaxations for reducing anxiety levels (García et al., 2011), but it is also more complex and needs more practice by students.

In the present study, as in a recent study, students reported symptoms of anxiety in the face of the COVID-19 pandemic. Specifically, women in this study reported more anxiety than men. As with previous studies (Raya, 2009), the results of our study show the usefulness of relaxation techniques in reducing anxiety. However, although anxiety levels had decreased, there were still students in the post-test who were still anxious. For this reason, it was recommended that they continue to practice relaxation techniques after the study was completed.

In the discussion group, participants reported that practicing different relaxation techniques helped them decrease anxiety levels. Similarly, students said that learning these techniques in the current context of the crisis caused by the COVID-19 virus had been very appropriate for both academic learning and practical application. According to the results, at the beginning of the practice, they were not able to focus on these techniques, but as they practiced, the levels of relaxation improved considerably. This is due, as Amutio et al. (2015) point out, to the need for practice in the acquisition and improvement of relaxation techniques.

The learning of these techniques is beneficial not only for the present moment but also for your usual routine and your future profession. More than 20% of the students suffer from high levels of anxiety about university studies, and their performance is significantly reduced (Baeza et al., 2008). Similarly, it should be borne in mind that the situation of lockdown, fear, and uncertainty that the current pandemic seems to be creating may aggravate these anxiety levels (Qiu et al., 2020). Furthermore, we believe that it is especially significant that future teachers acquire the ability to manage anxiety since they will be referents and caregivers of children from 0 to 6 years old, a highly sensitive stage of development (López, 2005). Within this context, several studies show that teachers with lower levels of anxiety have a greater capacity to transmit well-being to students. In addition, calmer students develop a greater capacity for concentration and creativity and, in short, a greater ability to learn new content.

With this background, one of the main practical applications of this research has been to guide the effectiveness of non-pharmacological therapies, specifically relaxation techniques in a pandemic crisis situation, such as the one being experienced worldwide by COVID-19. This finding is very important taking into account that we are facing a population in which the

consumption of anxiolytic drugs to combat anxiety is very high (Aznar et al., 2017), with women consuming the most. In this sense, it can be stated that psychoeducation about anxiety and training in relaxation techniques in a telematics way are new ways of dealing with anxiety symptoms and preventing the consumption of anxiolytics.

It should be noted that this research also has some limits that should be mentioned. Firstly, although the results obtained with the program carried out telematically have been satisfactory, the sample size is not significant. Secondly, the sample lacks homogeneous criteria since most of the participants are women. Thirdly, the study is mainly based on self-questionnaires. This may lead to confusion on the part of the participant when carrying out the study. Finally, there was no investigation into how anxiety symptoms were seen by other familial figure.

CONCLUSION

The present research shows that relaxation techniques help to reduce the levels of anxiety that students may be experiencing when facing COVID-19.

On the other hand, telematics classes are an adequate way to reach this student body, and psychoeducation can be exercised through this means.

In short, it is important to take care of the mental health of the university students, and the effectiveness of a program created for a group of students at a university in northern Spain has been shown.

REFERENCES

- Abuín, M. (2016). Terapia autógena: técnicas, fundamentos, aplicaciones en la salud y clínica y apoyo empírico. *Clín. Salud*. 27, 133–145. doi: 10.1016/j.clysa.2016.09.004
- Amutio, A., Justo, C. F., Linares, J. J., and Mañas, I. M. (2015). Aprendizaje y práctica de la conciencia plena en estudiantes de bachillerato para potenciar la relajación y la autoeficacia en el rendimiento escolar. *Univ. Psychol*. 14, 433–443. doi: 10.11144/Javeriana.upsyl14-2.apcp
- Aritzeta, A., Soro, A. G., Balluerka, N., Muela, A., Gorostiaga, A., and Aliri, J. (2017). Reducing anxiety and improving academic performance through a biofeedback relaxation training program. *Appl. Psychophysiol. Biofeedback* 42, 42193–42202. doi: 10.1007/s10484-017-9367-z
- Armat, M. R., Emami Zeydi, A., Mokarami, H., Nakhband, A., and Hojjat, S. K. (2020). The impact of laughter yoga on depression and anxiety among retired women: a randomized controlled clinical trial. *J. Women Aging* 18, 1–12. doi: 10.1080/08952841.2020.1774225
- Aznar, M. P., García, L., Bethencourt, J. M., and Rodríguez-Wangüemert, C. (2017). Género y uso de medicamentos ansiolíticos e hipnóticos en España. *J. Fem. Gen. Women Stud.* 5, 23–31.
- Baeza, J. C., Balaguer, G., Belchi, I., Coronas, M., and Guillamón, N. (2008). *Higiene y Prevención de la Ansiedad*. Madrid: Ediciones Díaz de Santos.
- Burgos Varo, M. L., Fernández, M. D. O., Cobos F. M., Gutiérrez, P. V., and Aragón, R. B. (2006). Intervención grupal en los trastornos de ansiedad en Atención Primaria: técnicas de relajación y cognitivo-conductuales. *Semergen. Med. Fam.* 32, 205–210. doi: 10.1016/S1138-3593(06)73258-0
- Bushell, J. (1998). *Guide-Lines for Assessing and Treating Anxiety Disorders*. New Zealand: National Health Committee Guidelines Group.
- Chen, Y. F., Huang, X. Y., Chien, C. H., and Cheng, J. F. (2017). The effectiveness of diaphragmatic breathing relaxation training for reducing anxiety. *Perspect. Psych. Care*. 53, 329–336. doi: 10.1111/ppc.12184

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the UPV/EHU. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AM, MG, and NO-E were involved in the conceptualization of the project and in the acquisition and analysis of the data. MD was involved in the interpretation of the data. All authors were involved in the drafting and revising of the work for intellectual content, provided approval for submission of the contents for publication, and agreed to be accountable for the accuracy and integrity of the project.

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- Gadea, M., Aliño, M., Hidalgo, V., Espert, R., and Salvador, A. (2020). Effects of a single session of SMR neurofeedback training on anxiety and cortisol levels. *Neurophysiol. Clin.* 50, 167–173. doi: 10.1016/j.neucli.2020.03.001
- Gallego, I. D., Delgado, A. O., and Queija, I. S. (2011). Apego a los iguales durante la adolescencia y la adultez emergente. *Ann. Psychol.* 27, 155–163.
- García, J., Burgos, M., Paz, J., Santa Cruz, J., Canalejo, A., and Muñoz Cobos, F. (2011). Estudio controlado de utilidad de la intervención grupal mediante técnicas de relajación en la reducción de la ansiedad. *Med. Fam. Andalucía* 12, 141–149.
- García-Campayo, J., Zamorano, E., Ruiz, M. A., Pardo, A., Pérez-Páramo, M., López-Gómez, V., et al. (2010). Cultural adaptation into Spanish of the generalized anxiety disorder-7 (GAD-7) scale as a screening tool. *Health Qual Life Outcomes* 8:8. doi: 10.1186/1477-7525-8-8
- Hao, F., Tan, W., Jiang, L., Zhang, L., Zhao, X., Zou, Y., et al. (2020). Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. *Brain Behav. Immun.* 87, 100–106. doi: 10.1016/j.bbi.2020.04.069
- Hernández-Pozo, M., Coronado, O., Araújo, V., and Cerezo, S. (2008). Desempeño académico de universitarios en relación con ansiedad escolar y auto-evaluación. *Act. Col. Psic.* 11, 13–23.
- Jung, I., Kudo, M., and Choi, S. K. (2012). Stress in Japanese learners engaged in online collaborative learning in English. *Br. J. Educ. Technol.* 43, 1016–1029. doi: 10.1111/j.1467-8535.2011.01271.x
- Justo, C. F. (2008). Programa de relajación y de mejora de autoestima en docentes de educación infantil y su relación con la creatividad de sus alumnos. *Rev. Iberoam. de Educ.* 45, 10.
- Lether, P. (1996). Varieties of relaxation methods and their unique effects. *Int. J. Stress Manage.* 3, 1–15. doi: 10.1007/bf01857884

- López, D. T., Tixi, D. L. D., Quinde, S. P. C., Niama, M. P. C., and Chunata, N. M. I. (2019). Técnicas psicológicas para manejar el estrés académico en el proceso de aprendizaje del idioma inglés. *ESJ* 15, 421–428. doi: 10.19044/esj.2019.v15n4p421
- López, E. (2005). La educación emocional en la educación infantil. *Rev. Interuniv. Form. Profr.* 54, 153–168.
- Lsalt, V., and Kerr, K. (1997). Mitchells simple physiological relaxation and jacobsons progressive relaxation techniques: a comparison. *Physiotherapy* 83, 200–207. doi: 10.1016/s0031-9406(05)66081-6
- Macias, J. J., and Valero, L. (2018). La psicoterapia on-line ante los retos y peligros de la intervención psicológica a distancia. *Apunt. Psicol.* 36, 107–113.
- Mármol, A. G. (2013). La relajación en niños: principales métodos de aplicación. *EmásF* 24, 35–43.
- Marquez-Domínguez, Y., González-Herrera, A. I., and Gutierrez-Barroso, J. (2018). Las titulaciones de la facultad de educación de la universidad de la laguna. un análisis desde la perspectiva de género. *Eur. Sci. J.* 14, 56–69. doi: 10.19044/esj.2018.v14n8p56
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., and Xu, Y. (2020). A nationwide survey of psychological distress among chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen. Psychiatr.* 33:e100213. doi: 10.1136/gpsych-2020-100213
- Rasid, Z. M., and Parish, T. S. (1998). The effects of two types of relaxation training on students level of anxiety. *Adolescence* 33, 99–99.
- Raya, A. (2009). Intervención grupal psicoeducativa en pacientes con ansiedad y depresión en atención primaria de Barcelona. *Aten. Prim.* 41, 227–232. doi: 10.1016/j.aprim.2008.09.028
- Rogero-García, J. (2020). La ficción de educar a distancia. *Rev. Soc. Educ.* 13, 174–182. doi: 10.7203/RASE.13.2.17126
- Rygiel, K. K. (2019). Deep diaphragmatic breathing: a “Portable Intervention” for stress reduction among university students. *Effects Stress Hum. Health* doi: 10.5772/intechopen.86731. Available online at: <https://www.intechopen.com/books/effects-of-stress-on-human-health/deep-diaphragmatic-breathing-a-portable-intervention-for-stress-reduction-among-university-students>
- Schultz, J. H. (1969). *El entrenamiento Autógeno. Autorrelajación Concentrativa*. Barcelona: Editorial.
- Smith, C. A., Levett, K. M., Collins, C. T., Armour, M., Dahlen, H. G., and Sukanuma, M. (2018). Relaxation techniques for pain management in labour. *Cochrane Database. Syst. Rev.* 28:CD009514. doi: 10.1002/14651858.CD009514.pub2
- Solomen, S., and Aaron, P. (2015). Breathing techniques-a review. *Int. J. Phys. Educ. Sports Health* 2, 237–241.
- Spitzer, R. L., Kroenke, K., Williams, J. B. W., and Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.* 166, 1092–1097. doi: 10.1001/archinte.166.10.1092
- Taylor, M. R., Agho, K. E., Stevens, G. J., and Raphael, B. (2008). Factors influencing psychological distress during a disease epidemic: data from Australia's first outbreak of equine influenza. *BMC Public Health*:8:347. doi: 10.1186/1471-2458-8-347
- Toro, M. T. (2019). Relajación de jacobson para disminuir la ansiedad originada por evaluaciones e incremento del rendimiento académico en estudiantes de psicología de una universidad privada de Lima Metropolitana. *Av. Psicol.* 27, 167–176. doi: 10.33539/avpsicol.2019.v27n2.1795
- Vaccaro, M. G., Izzo, G., Ilacqua, A., Migliaccio, S., Baldari, C., Guidetti, L., et al. (2019). Characterization of the effects of a six-month dancing as approach for successful aging. *Int. J. Endocrinol.* 2, 1–7. doi: 10.1155/2019/2048391
- World Health Organization (WHO). (2018). *Adolescents: Health Risks and Solutions*. Available online at: <https://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions>

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Corrigendum: Reduction of COVID-19 Anxiety Levels Through Relaxation Techniques: A Study Carried Out in Northern Spain on a Sample of Young University Students

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An author name was incorrectly spelled as ****Maria Dosil Santa María****. The correct spelling is ****María Dosil Santamaría****.

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

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Fear of COVID-19, Stress, and Anxiety in University Undergraduate Students: A Predictive Model for Depression

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Depression is a disabling illness which increases the risk of suicide. The Corona Virus Disease 2019 (COVID-19) pandemic has led to a rise in fear, anxiety, stress, and depression among the population: of these, university undergraduates from countries severely affected by COVID-19 are some of the most vulnerable of all, as they face strict lockdown measures and have fewer resources to cope with it. The aim of this study was to analyze the levels of fear of COVID-19, stress, anxiety, and depression during lockdown among undergraduates from Ecuador, and to test these possible predictors of depression using a model taken from our study of the scientific literature. A total of 640 undergraduates (72% women) between 18 and 47 years old ($M = 21.69$; $S.D = 4.093$) were surveyed. The resulting mean levels found for stress, anxiety, and depression were above levels considered non-pathological. Women showed higher levels of fear of COVID-19 than men. The statistical prediction for depression showed a good fit. This depression could be related: both directly and positively by fear of COVID-19 and stress, and indirectly, as a result of these two factors, positively mediated by anxiety. Our study concludes by highlighting the important role that the complex relationships between fear, stress, and anxiety can play in the development of depression symptoms and how they can be taken into account in programs aimed at preventing and alleviating this disorder. We propose some general measures for reducing fear of COVID-19 and stress and suggest that specific programs be designed to control and overcome anxiety among undergraduates.

Keywords: COVID-19, depression, fear, stress, anxiety, undergraduate students

INTRODUCTION

Depression is one of the main factors that generates disability in populations in modern societies (Dong et al., 2020; Nuggerud-Galeas et al., 2020). Having experienced epidemics or natural disasters increases long-term levels of depression in populations (Mak et al., 2009; Lee et al., 2018; Morganstein and Ursano, 2020) and may also increase their future suicide rates (Cheung et al., 2008). Experiencing more upsetting events in life and finding it difficult to cope with them are also predictors of anxiety, stress, and depression (Zou et al., 2018).

At present, the world is facing a critical situation caused by the Severe Acute Respiratory Syndrome (SARS)-CoV-2 virus, and this has contributed hugely toward increasing levels of depression in the population in different countries. The situation of the population in some countries which have been severely affected by the epidemic and have little ability to cope, as is occurring in several Latin American countries, is particularly alarming. In the current epidemic crisis, studying the causes of depression in vulnerable contexts can be of great strategic value to help alleviate this illness now and prevent it in the future.

COVID-19 in Latin America

In Latin American countries, the first case was reported in Brazil on February 25, 2020 (Rodríguez-Morales et al., 2020), and after that, the disease expanded rapidly throughout this vast region. In Ecuador, there are now over 65,000 people infected, and this country has become one of the worst affected in all Latin America (Muñoz, 2020). Like other countries with limited financial resources and deficient healthcare facilities, Ecuador has had serious difficulties in identifying possible cases of infection, stopping its spread, and treating patients (Hoffman and Silverberg, 2018; Kapata et al., 2020). This critical situation, set in a context of great vulnerability, can lead to a feeling of extreme helplessness among the population, which particularly affects mental health (Llibre-Guerra et al., 2020). Thus, recent studies in Latin American countries have found that health care workers have symptoms of anxiety and distress (Chen et al., 2020b; Yáñez et al., 2020; Zhang et al., 2020); while, in other studies, almost half reported symptoms of depression (Guiroy et al., 2020). However, despite the fact that some studies have reported that these symptoms occur to a greater extent in the population between 18 and 28 years of age (Cortés-Álvarez et al., 2020), hardly any studies have been carried out in university students.

The COVID-19 Pandemic and Depression

The SARS-CoV-2 virus particularly affects the respiratory system and is highly infectious, with a long incubation period. The World Health Organization (WHO) has named the disease Corona Virus Disease 2019 (COVID-19; Wu et al., 2020). It was first discovered in the city of Wuhan (China) in 2019, but its remarkable ability to spread and its rapid expansion around the world has led the WHO to consider it a pandemic (Rothan and Byrareddy, 2020). This pathogen has now become one of the worst health, social, and economic problems worldwide in recent years (Nicola et al., 2020). A number of studies have shown the impact that COVID-19 can have and its effects on people's well-being, due to its ability to produce a full-scale mental health crisis, especially in countries with a large number of people affected by the disease (Fiorillo and Gorwood, 2020). A number of studies have already begun to look at psychological disorders such as depression in populations affected by COVID-19 (e.g., Duan and Zhu, 2020; Gao et al., 2020; Huang and Zhao, 2020). Depression is a disorder made up of symptoms associated with low morale—despair, sadness, self-depreciation, and

worthlessness—leading to reduced self-esteem and lack of interest in life. The disorder is closely linked to a lower probability of achieving significant life goals for those who suffer from it, with worsening health and with suicide attempts (Antúnez and Vinet, 2012; Roh et al., 2020; Siegrist and Wege, 2020; Zhuo et al., 2020). In order to prevent and alleviate depression during the current crisis and in the post-COVID-19 world, we need to look into the factors associated with this disorder.

Fear of COVID-19, Stress, Anxiety, and Depression

The pandemic has forced many governments to bring in strict laws to stop it from spreading (Adhikari et al., 2020). The governments of the worst affected countries, in terms of number of infections, patients, and mortality levels, such as China, Italy, Spain, and Ecuador, have decreed long periods of self-isolation and/or lockdown, in which citizens have had to stay home. This has seriously affected the living conditions of their populations, and it has been especially detrimental in countries with fewer resources, such as those in the Latin American region. Certain aspects of the disease, such as the uncertainty about how it is spread, its evolution or about the immunity of patients who have been infected, or the absence of a vaccine to counter the disease, have led to an increased feeling of fear among the population (Orellana and Orellana, 2020; Ornell et al., 2020; Rodríguez-Rey et al., 2020).

These fears, generated by the perception of threatening stimuli, have already been seen in previous epidemics, such as those caused by SARS (Reynolds et al., 2008) or Middle East Respiratory Syndrome-Coronavirus (MERS-CoV; Bukhari et al., 2016). Given the severe global threat and impact that the COVID-19 pandemic has produced on different aspects of human survival, health, well-being, and development, Ahorsu et al. (2020) designed a scale to measure the fear of this pathogen based on the existing scientific literature: the Fear of COVID-19 Scale (FCV-19S). This scale has been used in a wide range of countries, such as Iran (Alyami et al., 2020), Bangladesh (Sakib et al., 2020), Italy (Soraci et al., 2020), Turkey (Satici et al., 2020), Russia and Belarus (Reznik et al., 2020), Israel (Tzur Bitan et al., 2020), Peru (Huaracaya-Victoria et al., 2020), and Paraguay (Barrios et al., 2020).

Most of these studies also detected a link between fear of COVID-19 and anxiety (Mertens et al., 2020) and, to a lesser extent, depression, using both the Hospital Anxiety and Depression Scale (HADS; Ahorsu et al., 2020; Alyami et al., 2020) and the Depression and Anxiety Stress Scale (DASS-21). It has recently been observed that fear of COVID-19 is associated more with anxiety and stress and to a lesser extent with depression (Tzur Bitan et al., 2020). Nevertheless, despite the fact that there seems to be a lesser association between fear and depression, cases of suicide have been reported in the population due to fear of COVID-19 (Mamun and Griffiths, 2020).

In addition, the high daily rates of new cases and deaths together with the bombardment of information to which citizens are submitted through the media can influence the development

of mood disorders (Duan and Zhu, 2020; Gao et al., 2020). Thus, from the early stages of the pandemic, Chinese researchers found moderate and severe symptoms of anxiety, stress, and depression in the Chinese population (Huang and Zhao, 2020).

The relationships between stress, anxiety, and depression have long been documented in the scientific literature. The theoretical models, supported by scientific evidence, link socioenvironmental stress with internal biological processes that drive the pathogenesis of depression (e.g., Slavich and Irwin, 2014; Park et al., 2019). Longitudinal studies in young people also suggest that stress predicts depression (e.g., Agoston and Rudolph, 2011). We know that in highly stressful situations, there is a close link between anxiety and depression (Díaz et al., 2012), for instance, in people suffering from post-traumatic stress disorder, who often show high levels of fear and anxiety (Forbes et al., 2010). Anxiety and depression are also known to be positively related (Jansson-Fröjmark and Lindblom, 2008) and both function as predictors of each other (Jacobson and Newman, 2017; Hovenkamp-Hermelink et al., 2019).

In the current crisis caused by the pandemic, the emerging literature is beginning to reveal certain differences based on gender and age. Women and younger people show higher levels of depression, anxiety, stress, and fear of COVID-19 (Huang and Zhao, 2020; Sandín et al., 2020). However, most of these studies were carried out in samples of health workers (Pappa et al., 2020), and much less is known about young people. Undergraduate students at university have been observed to be more fearful of COVID-19 than graduates (Reznik et al., 2020). In addition, according to some studies, the symptoms of anxiety and depression among these students are increasing due to social distancing and lockdown laws (Chen et al., 2020a; Mazza et al., 2020; Santini et al., 2020).

The Present Study

After reviewing the emerging literature on the critical situation of global pandemic caused by COVID-19, it is clear that more research is needed on the possible predictors of depression. The focus of this study is university undergraduate students, who, in particular, seem to be a highly vulnerable population. We conducted the research in Ecuador, in order to learn more about the relationship between these psycho-social factors in a country potentially affected by high levels of stress and fear, with extremely restrictive measures of social distancing and lockdown in force, with high rates of new cases and deaths, and where the authorities face severe difficulties in meeting the health needs of its citizens.

This study aims to (a) measure the levels of fear of COVID-19, anxiety, stress, and depression of university students and any possible differences depending on gender and (b) test a model of structural equations with the possible variables related to depression, such as fear of COVID-19, stress, and anxiety. The hypotheses we studied were that: (1) women will show higher levels of fear of COVID-19, stress, anxiety, and depression than men; (2) fear of COVID-19 will have a positive relationship with depression, mediated through anxiety; and (3) stress will be positively and directly related to depression, also mediated through anxiety.

MATERIALS AND METHODS

Participants

The population consisted of 78,059 students from four universities from the province of Manabí (Ecuador): Universidad Laica Eloy Alfaro de Manabí, Universidad Técnica del Litoral, Universidad Técnica de Manabí, and Universidad Estatal del Sur de Manabí. The sampling was incidental, due to the accessibility. A total of 640 undergraduates took part in the research. Of the full sample, 72% were women ($n = 461$) and 28% men ($n = 179$). The age of the participants ranged from 18 to 47 years ($M = 21.69$; $S.D = 4.093$).

Instruments

We applied the Spanish version (Huarcaya-Victoria et al., 2020) of the FCV-19S (Ahorsu et al., 2020), which features a Likert-type scale made up of seven items [e.g., *My hands become clammy when I think about Coronavirus (COVID-19)*]. The instrument presented high reliability for the study sample ($\alpha = 0.904$).

We also used the Spanish version (Fonseca-Pedrero et al., 2010) of the DASS-21 (Lovibond and Lovibond, 1995), which reports on stress levels (irritability, edginess, and/or inability to relax), anxiety (nervousness or physiological tension), and depression (feeling a loss of interest in daily activities, in life or in oneself) in the university population. This instrument is composed of three subscales, each containing seven items: (a) F1 = Stress (e.g., *I found it difficult to relax*), (b) F2 = Anxiety (e.g., *I was aware of dryness of my mouth*), and (c) F3 = Depression (e.g., *I could not seem to experience any positive feeling at all*). The instrument showed good reliability for the study sample ($\alpha^{\text{TOTAL}} = 0.954$; $\alpha^{\text{STRESS}} = 0.907$; $\alpha^{\text{ANXIETY}} = 0.861$; and $\alpha^{\text{DEPRESSION}} = 0.875$).

Procedure

Before data collection, we first contacted the lecturers at several Ecuadorian universities who, under normal conditions, gave face-to-face lectures, but due to the COVID-19 lockdown, were currently teaching online. We organized a day on which the lecturers could respond to the online questionnaires. We also conferred with them *via* videoconferencing about how to complete the questionnaires and answered their queries.

On the day the questionnaires were collected, in Ecuador, 39,098 cases of sickness and 3,358 deaths from COVID-19 were recorded. At the end of the period for collecting the questionnaires, the number of patients was 84,370 and the number of deaths was 5,657 (Ministerio de Salud Pública del Ecuador, 2020; Servicio Nacional de Gestión de Riesgos y Emergencias, 2020).

Before the data were collected, all the participants, who were all over 18, gave their written informed consent. During the procedure, they were informed that no individual results, or any information that could identify them as study participants, would be published. Likewise, they were explicitly informed of the voluntary, anonymous, and confidential nature of the data provided and of the possibility of withdrawing at any

time, without having to give any explanation or being penalized in any way. The questionnaires were completed individually and took approximately 15 min to complete.

The study was carried out in line with the ethical criteria established in the Declaration of Helsinki. The procedure was approved by the Ethical Committee of the Directorate for Research and Social and Technological Innovation of the University Laica Eloy Alfaro of Manabí (Ecuador), code II-COVID-19ULEAM2020.

Data Analysis

Descriptive analyses with cut-off points were performed to analyze the mean scores on the DASS-21, and we took into account the cut-off points for the DASS-21 instrument given by other authors in order to obtain homologous samples of age, population, and culture. According to these authors, values of over 6 for stress and depression and 5 for anxiety showed the existence of mood disorders.

Comparative analyses were also conducted to establish differences between the scores for fear of COVID-19, stress, anxiety, and depression according to gender, for which the Mann-Whitney *U* test of independent samples was used. These analyses were carried out using the statistical program SPSS v.20. The confidence level applied in all the analyses was 95% ($p < 0.05$) or 99% ($p < 0.01$), depending on the case. The effect size was calculated with Cohen's *d*.

A Structural Equation Model was performed to find out which variables are related to depression in undergraduate university students, using the EQS 6.2 program. Taking into account the ordinal nature of the data and the absence of normality, we decided to generate a polychoric correlation matrix (Flora and Curran, 2004) and use the robust estimation method (Bentler, 2006).

To evaluate the fit of the model, we took into account the values of the Satorra-Bentler chi-square (χ^2 S-B), the Satorra-Bentler chi-square divided by degrees of freedom (χ^2 S-B/*df*; values ≤ 2 were considered as optimal) and other indices which are not affected by the sample size: *Non-Normed Fit Index* (NNFI), *Normed Fit Index* (NFI), *Comparative Fit Index* (CFI), and *Incremental Fit Index* (IFI). As a criterion for assuming an adequate fit of the model, values of ≥ 0.95 in the above indices (Bentler, 1992) were established. For the *Root Mean Square Error of Approximation* (RMSEA), values between 0.05 and 0.08 were considered suitable to indicate an acceptable fit and ≤ 0.05 to indicate a good fit (Hu and Bentler, 1999).

RESULTS

Fear of COVID-19, Stress, Anxiety, and Depression of University Undergraduates in Ecuador Based on Gender

The results of the Mann-Whitney *U* test of independent samples showed the existence of significant differences between men and women in the fear of COVID-19 scores (see **Table 1**). The scores obtained from the FCV-19S were higher for women than for men.

TABLE 1 | Differences in fear of COVID-19, stress, anxiety, and depression scores according to gender.

Scale	Range (Men; <i>n</i> = 179)	Range (Women; <i>n</i> = 461)	<i>U</i>	<i>p</i>	<i>d</i>
Fear of COVID-19	255.84	345.61	29684.5	0.000**	0.45
Stress	304.8	326.6	38,449	0.180 ^{ns}	0.10
Anxiety	304.51	326.71	38,397	0.171 ^{ns}	0.10
Depression	315.34	322.5	40,336	0.659 ^{ns}	0.05

ns, not significant; *d*, Cohen's *d*. ** $p < 0.01$.

However, no statistically significant differences were detected for the levels of stress, anxiety, and depression between men and women studying in Ecuador.

Structural Equation Model for Depression in University Undergraduates

The results obtained for the model of depression in university undergraduates during lockdown showed optimal goodness-of-fit indices: χ^2 S-B(341) = 894.2207, $p < 0.001$; χ^2 S-B/*df* stood at a value of ≤ 3 , which is considered as optimal (Hu and Bentler, 1999), NFI = 0.99, NNFI = 0.98, CFI = 0.99, IFI = 0.99, and RMSEA = 0.05 [90% CI (0.046, 0.054)].

The model presented a good fit for men and women. For women, the model presented the following values: χ^2 S-B(341) = 808.2548, $p < 0.001$; NFI = 0.99, NNFI = 0.98, CFI = 0.99, IFI = 0.99, and RMSEA = 0.055 [90% CI (0.050, 0.059)], while for men, the model presented the following values: χ^2 S-B(342) = 610.7503, $p < 0.001$; NFI = 0.96, NNFI = 0.98, CFI = 0.98, IFI = 0.98, and RMSEA = 0.066 [90% CI (0.058, 0.075)].

Figure 1 shows the Structural Equation Model for the relationship between fear of COVID-19 and stress in depression, with anxiety taken as a mediator of these variables. The relationship between fear of COVID-19 and depression is not shown in the figure as it is not significant. Due to the absence of normality, the robust maximum likelihood estimation method was used for the model (Mardia coefficient = 250.8931).

The model showed that the variables of fear of COVID-19 ($\beta = -0.04$; $p < 0.05$) and stress responses ($\beta = 0.76$; $p < 0.05$) have direct effects on anxiety during lockdown. The relationship between these variables accounts for 60.3% of the variance in anxiety.

The model also revealed that the variables for stress ($\beta = 0.37$; $p < 0.05$) and anxiety ($\beta = 0.57$; $p < 0.05$) reveal direct effects on depression during lockdown. The relationship between these model variables accounts for 79.8% of the variance in depression.

The standardized indirect effect values were: (a) for fear of COVID-19 > Anxiety > Depression = 0.023 and (b) for Stress > Anxiety > Depression = 0.43.

High, direct correlation values were observed in the polychoric matrix between the fear scale and the DASS-21 subscales (see **Table 2**). Similarly, the scores obtained show the existence of affective states of stress ($M = 6.89$), anxiety ($M = 5.53$), and depression ($M = 5.93$), as high scores were found in our study.

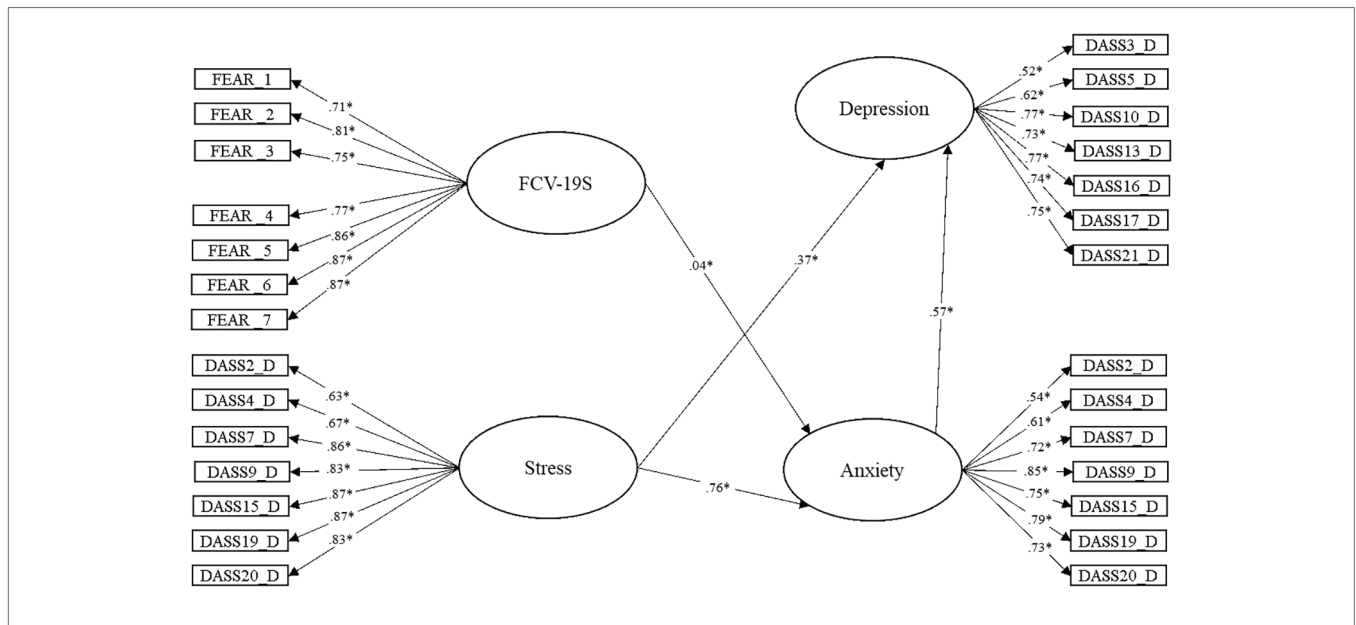


FIGURE 1 | Significant relationships of the Structural Equation Modeling for the statistical prediction of depression in university undergraduates from Ecuador.

TABLE 2 | Descriptive statistics and polychoric correlations for the Fear of COVID-19 Scale (FCV-19S) and subscales of the Depression and Anxiety Stress Scale (DASS-21).

Scales	n (640)		1	2	3	4
	M	S.D				
1 Fear of COVID-19	14.37	5.381	1			
2 Stress	6.89	5.541	0.325	1		
3 Anxiety	5.53	4.989	0.285	0.816	1	
4 Depression	5.93	5.077	0.286	0.775	0.862	1

DISCUSSION

The primary objective of this research was to measure the levels of fear of COVID-19, anxiety, stress, and depression and their possible differences by gender among university students in Ecuador. It is clear that the participants, as a group, show high levels of stress, anxiety, and depression, and the levels recorded are above the cut-off points described in the scientific literature for each of these phenomena in similar populations of young undergraduates (e.g., Román et al., 2016). This shows that major psychological health problems exist among university students in the context of the COVID-19 lockdown, which is consistent with the moderate to severe symptoms of anxiety, stress, and depression observed in the Chinese population in the early stages of the pandemic (Huang and Zhao, 2020).

Our first hypothesis has been partially corroborated. Female undergraduates suffer higher levels of fear of COVID-19 than their male counterparts, as observed in the few similar studies carried out in other countries (Huang and Zhao, 2020; Sandín et al., 2020). However, no significant gender differences were found for levels of anxiety, stress, and depression, which does

not concur with the observations of some studies carried out during the pandemic which show women to be more vulnerable to these disorders (e.g., Huang and Zhao, 2020; Sandín et al., 2020).

These findings provide new knowledge, since in most of the emergent scientific literature on this topic, these levels have been studied in health workers rather than undergraduates (Pappa et al., 2020). We suggest that the academic demands of university studies and the uncertain outlook take its toll on their learning and evaluation processes, leading to emotions of anxiety, stress, and depression in both female and male students, regardless of their gender.

The second main aim of the research was oriented toward studying how the influence of fear of COVID-19, stress, and anxiety relate to depression. We designed a model based on a review of the previous scientific literature and contrasted it with the collected data. The results obtained in the structural equations showed an excellent fit to the model. The model showed a good fit in both men and women. The second and third hypotheses of the study were, therefore, corroborated. The model shows how depression was directly and positively related by stress levels and indirectly through fear of COVID-19 and stress, mediated by the level of anxiety.

The relationship we observed for fear of COVID-19 with depression is consistent with some of the previous studies (Ahorsu et al., 2020; Alyami et al., 2020; Tzur Bitan et al., 2020). The relationships between fear of COVID-19 and anxiety (Mertens et al., 2020) and between anxiety and depression (Jansson-Fröjmark and Lindblom, 2008; Jacobson and Newman, 2017; Hovenkamp-Hermelink et al., 2019; Chen et al., 2020a) have also been documented separately. However, the relationship of fear of COVID-19 with depression, mediated by anxiety, has not been described before, making this a novel contribution. In addition, the relationship of stress with depression we observed concurs with some of the previous studies

(Agoston and Rudolph, 2011; Slavich and Irwin, 2014; Park et al., 2019). The relationships between stress and anxiety and between anxiety and depression have been described previously (Díaz et al., 2012; Chen et al., 2020a). However, the influence of stress on depression, mediated by anxiety, during the social isolation caused by the pandemic, has not been described before in the literature. Furthermore, the indirect effect of FCV-19 on anxiety and depression was less than the indirect effect of stress on anxiety and depression.

The conditions in which people in Ecuador have to cope with the pandemic are extremely adverse in many ways. The rapid spread of the disease, the large number of people affected, the mounting number of deaths, a mistrust of the health system, ignorance, and disinformation may have all contributed significantly to the fact that young university students experience fear of COVID-19. This fear has been revealed as a factor that influences depression, and the effect of this fear on depression could be worsened by the existence of anxiety.

Undergraduate students tend to feel more fear when they feel they are in a more vulnerable situation and in greater danger, since many of them live away from the family home, and are unable to return and/or live in poor conditions where it is difficult to stay healthy and make ends meet.

Young female and male undergraduates are at a stage in their lives when they are planning their future, trying to find work, and trying to set up the conditions to become independent from their parents and fend for themselves. In the case of university students in Ecuador, most of them, even in normal conditions before the pandemic, were already making great sacrifices, together with their families, to meet the economic and academic requirements needed to be admitted to, follow, and make the most of a university education. Ecuador is a source country for emigration, due to the lack of job opportunities and its low standard of living and poor living conditions, which, due to the epidemic, are most likely to get worse.

The learning and assessment processes in university studies have been changed, in most cases, from face-to-face classes to distance and/or online learning, which has led to greater difficulties among students to access learning and adapt to the new methods. Many undergraduates formerly worked to earn some extra money but have been unable to continue, due to lockdown. All of these issues may well have increased stress levels, influencing depression. The stress produced by these long-lasting, dramatic changes faced by young university students can directly lead to symptoms of depression or initially result in a state of anxiety that could later lead to depression.

According to the results of this study, the uncertainty and the danger perceived by the undergraduates can become a fertile breeding ground for fear, stress, anxiety, and, as a result, depression. Knowing how complex the interactions are between these factors and worsening symptoms of depression, we urgently need to design intervention plans in universities to help these young people cope better with this type of situation.

The contributions of this study reinforce the observations made in a previous study that the university undergraduate population is more vulnerable, in a psycho-social sense, in the situation of pandemic and lockdown, than that of university

graduates (Reznik et al., 2020). They also reinforce the conclusions drawn in some studies, which state that the lockdown measures have increased anxiety and depression among university undergraduates (Mazza et al., 2020; Santini et al., 2020). Our findings show that women, within this group, need preferential attention as regards strategies or measures to alleviate and prevent fear of COVID-19.

This study has certain limitations. The cross-sectional design, despite being suitable for the type of objectives we proposed, does not allow us to draw cause-effect conclusions. Future studies should be longitudinal to enable us to learn how the different factors affect the evolution of depression. The use of self-reports also has some limitations. The study was carried out in university students and the results cannot be generalized to the rest of the population. The sample is not balanced as regards gender, because it was incidental, which means that our interpretation of this variable is limited. The measurements used are all of the self-report type and subject to method variance effects and response biases, such as socially desirable responding. In future studies, this information-gathering technique should be supported by personal interviews. On the other hand, we consider that the instruments making up the self-report battery – which were previously validated and had good psychometric properties – were a success. In addition, another line of future research could study the relationship between the variables treated in this research and anxiety. Longitudinal studies could also be carried out to predict anxiety.

This study has allowed us to study in depth the complexity of depression in a situation of lockdown due to the pandemic. To continue progressing in future studies on the subject, it would be better to take into account registration measurements for other subject variables related to economic, employment status, housing conditions, goods and/or resources, among others. These sociodemographic aspects could shed more light on other factors which may be protectors or precursors of depression in a complex system which seems to be interwoven with fear, stress, and anxiety. It could also serve as a better to guide possible prevention and mitigation measures and optimize resources for the most vulnerable people within the overall group of university undergraduates.

Based on the model tested of depression in a pandemic, we propose different measures to prevent and alleviate this disorder. To reduce fear of COVID-19, it would be advisable to run convincing information campaigns about the disease, with training provided for its prevention and for effective coping strategies. Improving the health response could also help reduce fear, as there would be greater expectations of response in case of illness. Especially in the case of the university undergraduate population, the fear of COVID-19 could be increased by a feeling of inadequacy to face the difficult situation of the pandemic, by the lack of resources, to tackle a potential situation of disease and by poor or limited housing conditions, especially for undergraduate students living away from the family home.

Many of these university undergraduates have become ill and some have seen relatives become ill or die from COVID-19. Support plans with effective measures are needed to improve the undergraduates' standard of living, eating habits,

and living conditions. Many of them live in rooms or halls of residence in poor and/or overcrowded conditions. They should also be provided with internet access with sufficient bandwidth and the right hardware to be able to take part in distance learning. These steps could contribute to improving their ability to cope and/or to cushion the impact of these hardships.

The role of anxiety as a mediator between fear and stress and depression could lead to one innovative recommendation based on what we have observed in the present study. A program of attention and/or psychological training for undergraduates could be introduced, especially geared toward controlling and overcoming anxiety. Reducing anxiety could go a long way to alleviating the possible impact of fear and stress on depression. It would be advisable for the educational authorities, private bodies, and universities to urgently design and implement measures to alleviate these effects which harm the psychological health of their students. A society which does not protect and promote its young people's health and development in the present puts its immediate future in jeopardy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

REFERENCES

- Adhikari, S. P., Meng, S., Wu, Y. J., Mao, Y. P., Ye, R. X., Wang, Q. Z., et al. (2020). Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. *Infect. Dis. Poverty* 9, 1–12. doi: 10.1186/s40249-020-00646-x
- Agoston, A. M., and Rudolph, K. D. (2011). Transactional associations between youths' responses to peer stress and depression: the moderating roles of sex and stress exposure. *J. Abnorm. Child Psychol.* 39, 159–171. doi: 10.1007/s10802-010-9458-2
- Ahorsu, D. K., Lin, C. Y., Imani, V., Saffari, M., Griffiths, M. D., and Pakpour, A. H. (2020). The Fear of COVID-19 Scale: development and initial validation. *Int. J. Ment. Heal. Addict.* 1–9. doi: 10.1007/s11469-020-00270-8 [Epub ahead of print]
- Alyami, M., Henning, M., Krägeloh, C. U., and Alyami, H. (2020). Psychometric evaluation of the Arabic version of the Fear of COVID-19 Scale. *Int. J. Ment. Heal. Addict.* 1–14. doi: 10.1007/s11469-020-00316-x [Epub ahead of print]
- Antúnez, Z., and Vinet, E. V. (2012). Escalas de depresión, ansiedad y Estrés (DASS-21): Validación de la Versión abreviada en Estudiantes Universitarios Chilenos. *Ter. Psicol.* 30, 49–55. doi: 10.4067/S0718-48082012000300005
- Barrios, I., Ríos-González, C., O'Higgins, M., González, I., García, O., Díaz, N. R., et al. (2020). Psychometric properties of the Spanish version of the Fear of COVID-19 Scale (FCV-19S). *Int. J. Ment. Heal. Addict.* 1–14. doi: 10.21203/RS.3.RS-33345/V1 [Epub ahead of print]
- Bentler, P. M. (1992). On the fit of models to covariances and methodology to the bulletin. *Psychol. Bull.* 112, 400–404. doi: 10.1037/0033-2909.112.3.400
- Bentler, P. M. (2006). *EQS 6 structural equations program manual*. Los Angeles: BMDP Statistic Software.
- Bukhari, E. E., Temsah, M. H., Aleyadhy, A. A., Alrabiaa, A. A., Alhboob, A. A., Jamal, A. A., et al. (2016). Middle east respiratory syndrome coronavirus (MERS-CoV) outbreak perceptions of risk and stress evaluation in nurses. *J. Infect. Dev. Ctries.* 10, 845–850. doi: 10.3855/jidc.6925
- Chen, B., Sun, J., and Feng, Y. (2020a). How have COVID-19 isolation policies affected young people's mental health? – evidence from chinese college students. *Front. Psychol.* 11:1529. doi: 10.3389/fpsyg.2020.01529

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee of the Directorate for Research and Social and Technological Innovation of the University Laica Eloy Alfaro of Manabí (Ecuador). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors made substantial contribution to the theoretical framework, design, data collection, or interpretation of this study. All authors contributed to this article and approved its publication.

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- Chen, X., Zhang, S. X., Jahanshahi, A. A., Alvarez-Risco, A., Dai, H., Li, J., et al. (2020b). Belief in a COVID-19 conspiracy theory as a predictor of mental health and well-being of health care workers in Ecuador: cross-sectional survey study. *JMIR Public Health Surveill.* 6:e20737. doi: 10.2196/20737
- Cheung, Y. T., Chau, P. H., and Yip, P. S. F. (2008). A revisit on older adults suicides and Severe Acute Respiratory Syndrome (SARS) epidemic in Hong Kong. *Int. J. Geriatr. Psychiatry* 23, 1231–1238. doi: 10.1002/gps.2056
- Cortés-Álvarez, N. Y., Piñero-Lamas, R., and Vuelvas-Olmos, C. R. (2020). Psychological effects and associated factors of COVID-19 in a Mexican sample. *Disaster Med. Public Health Prep.* 1–12. doi: 10.1017/dmp.2020.215 [Epub ahead of print]
- Díaz, C. A., Quintana, G. R., and Vogel, E. H. (2012). Síntomas de depresión, ansiedad y estrés post-traumático en adolescentes siete meses después del terremoto del 27 de febrero de 2010 en Chile. *Ter. Psicol.* 30, 37–43. doi: 10.4067/S0718-48082012000100004
- Dong, L., Freedman, V. A., and de Leon, C. F. M. (2020). The association of comorbid depression and anxiety symptoms with disability onset in older adults. *Psychosom. Med.* 82, 158–164. doi: 10.1097/PSY.0000000000000763
- Duan, L., and Zhu, G. (2020). Psychological interventions for people affected by the COVID-19 epidemic. *Lancet Psychiatry* 7, 300–302. doi: 10.1016/S2215-0366(20)30073-0
- Fiorillo, A., and Gorwood, P. (2020). The consequences of the COVID-19 pandemic on mental health and implications for clinical practice. *Eur. Psychiatry* 63:e32. doi: 10.1192/j.eurpsy.2020.35
- Flora, D. B., and Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychol. Methods* 9, 466–491. doi: 10.1037/1082-989X.9.4.466
- Fonseca-Pedrero, E., Paino, M., Lemos-Giráldez, S., and Muñiz, J. (2010). Psychometric properties of the Depression Anxiety and Stress Scales-21 (DASS-21) in Spanish college students. *Ansiedad y Estrés* 16, 215–226.
- Forbes, D., Parslow, R., Creamer, M., O'Donnell, M., Bryant, R., McFarlane, A., et al. (2010). A longitudinal analysis of posttraumatic stress disorder symptoms and their relationship with fear and anxious-misery disorders: implications for DSM-V. *J. Affect. Disord.* 127, 147–152. doi: 10.1016/j.jad.2010.05.005

- Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., et al. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One* 15:e0231924. doi: 10.1371/journal.pone.0231924
- Guiroy, A., Gagliardi, M., Coombes, N., Landriel, F., Zanardi, C., Camino Willhuber, G., et al. (2020). COVID-19 impact among spine surgeons in Latin America. *Global Spine J.* 219256822092803. doi: 10.1177/2192568220928032 [Epub ahead of print]
- Hoffman, S. J., and Silverberg, S. L. (2018). Delays in global disease outbreak responses: lessons from H1N1, Ebola, and Zika. *Am. J. Public Health* 108, 329–333. doi: 10.2105/AJPH.2017.304245
- Hovenkamp-Hermelink, J. H., Jeronimus, B. F., Spinhoven, P., Penninx, B. W., Schoevers, R. A., and Riese, H. (2019). Differential associations of locus of control with anxiety, depression and life-events: a five-wave, nine-year study to test stability and change. *J. Affect. Disord.* 253, 26–34. doi: 10.1016/j.jad.2019.04.005
- Hu, L., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55. doi: 10.1080/10705519909540118
- Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 288:112954. doi: 10.1016/j.psychres.2020.112954
- Huarcaya-Victoria, J., Villarreal-Zegarra, D., Podestà, A., and Luna-Cuadros, M. A. (2020). Psychometric properties of a Spanish version of the Fear of COVID-19 Scale in general population of Lima, Peru. *Int. J. Ment. Heal. Addict.* 1–14. doi: 10.1007/s11469-020-00354-5 [Epub ahead of print]
- Jacobson, N. C., and Newman, M. G. (2017). Anxiety and depression as bidirectional risk factors for one another: a meta-analysis of longitudinal studies. *Psychol. Bull.* 143, 1155–1200. doi: 10.1037/bul0000111
- Jansson-Fröjmark, M., and Lindblom, K. (2008). A bidirectional relationship between anxiety and depression, and insomnia? A prospective study in the general population. *J. Psychosom. Res.* 64, 443–449. doi: 10.1016/j.jpsychores.2007.10.016
- Kapata, N., Ihekweazu, C., Ntoumi, F., Raji, T., Chanda-Kapata, P., Mwaba, P., et al. (2020). Is Africa prepared for tackling the COVID-19 (SARS-CoV-2) epidemic. Lessons from past outbreaks, ongoing pan-African public health efforts, and implications for the future. *Int. J. Infect. Dis.* 93, 233–236. doi: 10.1016/j.ijid.2020.02.049
- Lee, S. M., Kang, W. S., Cho, A. R., Kim, T., and Park, J. K. (2018). Psychological impact of the 2015 MERS outbreak on hospital workers and quarantined hemodialysis patients. *Compr. Psychiatry* 87, 123–127. doi: 10.1016/j.comppsy.2018.10.003
- Llibre-Guerra, J. J., Jiménez-Velázquez, I. Z., Llibre-Rodríguez, J. J., and Acosta, D. (2020). The impact of COVID-19 on mental health in the Hispanic Caribbean region. *Int. Psychogeriatr.* 1–9. doi: 10.1017/S1041610220000848 [Epub ahead of print]
- Lovibond, S. H., and Lovibond, P. F. (1995). *Manual for the depression anxiety stress scales*. 2nd Edn. Sydney, NSW: Psychology Foundation of Australia.
- Mak, I. W. C., Chu, C. M., Pan, P. C., Yiu, M. G. C., and Chan, V. L. (2009). Long-term psychiatric morbidities among SARS survivors. *Gen. Hosp. Psychiatry* 31, 318–326. doi: 10.1016/j.genhosppsy.2009.03.001
- Mamun, M. A., and Griffiths, M. D. (2020). First COVID-19 suicide case in Bangladesh due to fear of COVID-19 and xenophobia: possible suicide prevention strategies. *Asian J. Psychiatr.* 51:102073. doi: 10.1016/j.ajp.2020.102073
- Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., et al. (2020). A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int. J. Environ. Res. Public Health* 17:3165. doi: 10.3390/ijerph17093165
- Mertens, G., Gerritsen, L., Duijndam, S., Saleminck, E., and Engelhard, I. M. (2020). Fear of the coronavirus (COVID-19): predictors in an online study conducted in March 2020. *J. Anxiety Disord.* 74:102258. doi: 10.1016/j.janxdis.2020.102258
- Ministerio de Salud Pública del Ecuador (2020). El MSP informa: Situación coronavirus Covid-19. Available at: <https://www.salud.gov.ec/el-ministerio-de-salud-publica-del-ecuador-msp-informa-situacion-coronavirus/> (Accessed September 10, 2020).
- Morganstein, J. C., and Ursano, R. J. (2020). Ecological disasters and mental health: causes, consequences, and interventions. *Front. Psychol.* 11:1. doi: 10.3389/fpsyg.2020.00001
- Muñoz, N. (2020). COVID-19 in Latin America: a first glance to the mortality. *Colomb. Med.* 51:e4366. doi: 10.25100/CM.V51I2.4366
- Nicola, M., Alsaifi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., et al. (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): a review. *Int. J. Surg.* 78, 185–193. doi: 10.1016/j.ijso.2020.04.018
- Nuggerud-Galeas, S., Oliván Blázquez, B., Perez Yus, M. C., Valle-Salazar, B., Aguilar-Latorre, A., and Magallón Botaya, R. (2020). Factors associated with depressive episode recurrences in primary care: a retrospective, descriptive study. *Front. Psychol.* 11:1230. doi: 10.3389/fpsyg.2020.01230
- Orellana, C. I., and Orellana, L. M. (2020). Predictores de síntomas emocionales durante la cuarentena domiciliar por pandemia de COVID-19 en El Salvador. *Actual. Psicol.* 34, 103–120. doi: 10.15517/ap.v34i128.41431
- Ornell, F., Schuch, J. B., Sordi, A. O., and Kessler, F. H. P. (2020). “Pandemic fear” and COVID-19: mental health burden and strategies. *Braz. J. Psychiatry* 42, 232–235. doi: 10.1590/1516-4446-2020-0008
- Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V. G., Papoutsis, E., and Katsaounou, P. (2020). Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Brain Behav. Immun.* 88, 901–907. doi: 10.1016/j.bbi.2020.05.026
- Park, C., Rosenblat, J. D., Brietzke, E., Pan, Z., Lee, Y., Cao, B., et al. (2019). Stress, epigenetics and depression: a systematic review. *Neurosci. Biobehav. Rev.* 102, 139–152. doi: 10.1016/j.neubiorev.2019.04.010
- Reynolds, D. L., Garay, J. R., Deamond, S. L., Moran, M. K., Gold, W., and Styra, R. (2008). Understanding, compliance and psychological impact of the SARS quarantine experience. *Epidemiol. Infect.* 136, 997–1007. doi: 10.1017/S0950268807009156
- Reznik, A., Gritsenko, V., Konstantinov, V., Khamenka, N., and Isralowitz, R. (2020). COVID-19 fear in Eastern Europe: validation of the Fear of COVID-19 Scale. *Int. J. Ment. Heal. Addict.* 1–6. doi: 10.1007/s11469-020-00283-3 [Epub ahead of print]
- Rodríguez-Morales, A. J., Gallego, V., Escalera-Antezana, J. P., Méndez, C. A., Zambrano, L. I., Franco-Paredes, C., et al. (2020). COVID-19 in Latin America: the implications of the first confirmed case in Brazil. *Travel Med. Infect. Dis.* 35:101613. doi: 10.1016/j.tmaid.2020.101613
- Rodríguez-Rey, R., Garrido-Hernansaiz, H., and Collado, S. (2020). Psychological impact and associated factors during the initial stage of the Coronavirus (COVID-19) pandemic among the general population in Spain. *Front. Psychol.* 11:1540. doi: 10.3389/fpsyg.2020.01540
- Roh, S. C., Kim, J. S., Kim, S., Kim, Y., and Lee, S. H. (2020). Frontal alpha asymmetry moderated by suicidal ideation in patients with major depressive disorder: a comparison with healthy individuals. *Clin. Psychopharmacol. Neurosci.* 18:58. doi: 10.9758/cpn.2020.18.1.58
- Román, F., Santibáñez, P., and Vinet, E. V. (2016). Uso de las Escalas de Depresión Ansiedad Estrés (DASS-21) como Instrumento de Tamizaje en Jóvenes con Problemas Clínicos. *Acta Investig. Psicol.* 6, 2325–2336. doi: 10.1016/s2007-4719(16)30053-9
- Rothan, H. A., and Byrareddy, S. N. (2020). The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J. Autoimmun.* 109:102433. doi: 10.1016/j.jaut.2020.102433
- Sakib, N., Bhuiyan, A. K. M. I., Hossain, S., Al Mamun, F., Hosen, I., Abdullah, A. H., et al. (2020). Psychometric validation of the Bangla Fear of COVID-19 Scale: confirmatory factor analysis and rasch analysis. *Int. J. Ment. Heal. Addict.* 1–12. doi: 10.1007/s11469-020-00289-x [Epub ahead of print]
- Sandín, B., Valiente, R. M., García-Escalera, J., and Chorot, P. (2020). Impacto psicológico de la pandemia de COVID-19: Efectos negativos y positivos en población española asociados al periodo de confinamiento nacional. *Rev. de Psicopatol. y Psicol. Clin.* 25:1–22. doi: 10.5944/rppc.27569
- Santini, Z. I., Jose, P. E., York Cornwell, E., Koyanagi, A., Nielsen, L., Hinrichsen, C., et al. (2020). Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): a longitudinal mediation analysis. *Lancet Public Health* 5, 62–70. doi: 10.1016/S2468-2667(19)30230-0
- Satici, B., Gocet-Tekin, E., Deniz, M. E., and Satici, S. A. (2020). Adaptation of the Fear of COVID-19 Scale: its association with psychological distress and life satisfaction in Turkey. *Int. J. Ment. Heal. Addict.* 1–9. doi: 10.1007/s11469-020-00294-0 [Epub ahead of print]

- Servicio Nacional de Gestión de Riesgos y Emergencias (2020). Informes de Situación e Infografías—COVID 19—desde el 29 de Febrero del 2020. Available at: <https://www.gestionderiesgos.gob.ec/informes-de-situacion-covid-19-desde-el-13-de-marzo-del-2020/> (Accessed September 10, 2020).
- Siegrist, J., and Wege, N. (2020). Adverse psychosocial work environments and depression—a narrative review of selected theoretical models. *Front. Psychol.* 66:11. doi: 10.3389/fpsy.2020.00066
- Slavich, G. M., and Irwin, M. R. (2014). From stress to inflammation and major depressive disorder: a social signal transduction theory of depression. *Psychol. Bull.* 140, 774–815. doi: 10.1037/a0035302
- Soraci, P., Ferrari, A., Abbiati, F. A., Del Fante, E., De Pace, R., Urso, A., et al. (2020). Validation and psychometric evaluation of the Italian version of the Fear of COVID-19 Scale. *Int. J. Ment. Heal. Addict.* 1–10. doi: 10.1007/s11469-020-00277-1 [Epub ahead of print]
- Tzur Bitan, D., Grossman-Giron, A., Bloch, Y., Mayer, Y., Shiffman, N., and Mendlovic, S. (2020). Fear of COVID-19 Scale: psychometric characteristics, reliability and validity in the Israeli population. *Psychiatry Res.* 289:113100. doi: 10.1016/j.psychres.2020.113100
- Wu, Y. C., Chen, C. S., and Chan, Y. J. (2020). The outbreak of COVID-19: an overview. *J. Chin. Med. Assoc.* 83, 217–220. doi: 10.1097/JCMA.0000000000000270
- Yáñez, J. A., Afshar Jahanshahi, A., Alvarez-Risco, A., Li, J., and Zhang, S. X. (2020). Anxiety, distress, and turnover intention of healthcare workers in Peru by their distance to the epicenter during the COVID-19 crisis. *Am. J. Trop. Med. Hyg.* 103, 1614–1620. doi: 10.4269/ajtmh.20-0800 [Epub ahead of print]
- Zhang, S. X., Sun, S., Afshar Jahanshahi, A., Alvarez-Risco, A., Ibarra, V. G., Li, J., et al. (2020). Developing and testing a measure of COVID-19 organizational support of healthcare workers—results from Peru, Ecuador, and Bolivia. *Psychiatry Res.* 291:113174. doi: 10.1016/j.psychres.2020.113174
- Zhuo, L. B., Yao, W., Yan, Z., Giron, M. S., Pei, J. J., and Wang, H. X. (2020). Impact of effort reward imbalance at work on suicidal ideation in ten European countries: the role of depressive symptoms. *J. Affect. Disord.* 260, 214–221. doi: 10.1016/j.jad.2019.09.007
- Zou, P., Sun, L., Yang, W., Zeng, Y., Chen, Q., Yang, H., et al. (2018). Associations between negative life events and anxiety, depressive, and stress symptoms: a cross-sectional study among Chinese male senior college students. *Psychiatry Res.* 270, 26–33. doi: 10.1016/j.psychres.2018.09.019

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Effectiveness of Expressive Writing in the Reduction of Psychological Distress During the COVID-19 Pandemic: A Randomized Controlled Trial

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Objective: Due to the wide impact of the COVID-19 pandemic on mental health, the need for scalable interventions that can effectively reduce psychological distress has been recognized. Expressive writing (EW) can be beneficial for different conditions, including depression, suicidal ideation, and coping with trauma. Therefore, we aim to assess the applicability and effectiveness of an online format of EW in the reduction of psychological distress in context of the COVID-19 pandemic.

Methods: In this parallel-group, randomized controlled trial, participants ($n = 120$) were randomly allocated to (1) the intervention group—who completed five EW sessions over the 2 week period—or (2) the control group—who received treatment as usual (TAU). Participants were assessed for primary and secondary outcome measures at baseline, post-treatment, and follow-up-1-month after the treatment. The primary outcome was severity of psychological distress assessed at post-treatment, operationalized as Depression Anxiety Stress Scale (DASS) summary score. Secondary outcomes were severity of depression, anxiety, and stress (DASS subscale scores), well-being (WHO-5), subjective perception of quality of life (SQOL), and subjective evaluation of difficulties coping with pandemic, which were also assessed at post-treatment. Per protocol, analysis was conducted with available cases only.

Results: A less favorable outcome was found in the intervention group on psychological distress, and symptoms of stress, after controlling for baseline scores. Increased stress was recorded in the treatment group, with no effect in the control group. There was no significant difference between the groups on depression, anxiety, well-being, and subjective quality of life. No group effect for any of the outcomes measures was recorded at follow-up. Additional analysis revealed moderation effects of age and gender with older and male participants scoring higher on distress measures.

Conclusion: Engaging in EW during the pandemic was found to elevate stress; thus, when applied in the context of the COVID-19 pandemic, it may be harmful. Hence, EW or similar self-guided interventions should not be applied without prior

evidence on their effects in the context of a pandemic and similar stressful and unpredictable circumstances.

Clinical Trial Registration: This study is approved by the Institutional Ethics Committee (Protocol number #2020-20), and a trial has been registered at ISRCTN registry <https://www.isrctn.com/ISRCTN17898730>.

Keywords: expressive writing, online intervention, psychological distress, depression, anxiety, stress, well-being, mental health intervention (MeSH)

INTRODUCTION

The current COVID-19 pandemic brought numerous physical and mental health risks, which have been shown to lead to moderate to severe depression, anxiety, and traumatic stress-related difficulties in the general population (Wang et al., 2020). One study found that the prevalence of depression symptoms among US adults is threefold higher during the COVID-19 pandemic than before (Ettman et al., 2020). Similar trends were reported by a researcher from Hong Kong who found that a quarter of participants reported deteriorated mental health due to the pandemic, with elevated levels of depression and anxiety (Choi et al., 2020). In addition to the pandemic itself, various measures for the prevention and spread of COVID-19 have both short- and long-term negative impacts on mental health and well-being (Brooks et al., 2020). Finally, the negative social and economic impacts of the pandemic are expected, which represent additional risk factors for mental health. These multifactorial and complex effects should be expected to persist for a long period of time after the pandemic is over. To prevent and mitigate the negative effects of the COVID-19 pandemic, it was recognized that the development and implementation of mental health programs, including assessment, support, and treatment should be prioritized (Xiang et al., 2020).

With limited resources and the additional burden put on the public health care system during the pandemic, as well as restricted possibilities for the usage of traditional mental health services due to measures for prevention of COVID-19, such as physical distancing, there is a need for novel approaches, strategies, and interventions that reduce the short- and long-term negative psychological effects of the pandemic. Furthermore, the wide spread and the duration of the COVID-19 pandemic brought additional challenges to the mental health system as the number of people in need of psychosocial support increased beyond the capacities of mental health units even in the most developed countries. That is, there is a need for mental health interventions that are applicable to a large number of people, i.e., members of the general population without a history of mental health difficulties, who are experiencing pandemic-related psychological distress.

Expressive Writing

Expressive writing (EW) is an intervention in which one is asked to disclose one's deepest thoughts and feelings surrounding a stressful life event, initially introduced by Pennebaker in 1986 (Pennebaker and Chung, 2012; Andersson and Conley, 2013).

The idea behind EW is that one could decrease negative feelings, and improve physical and mental health, by engaging in deep and meaningful writing about a traumatic or difficult event. EW is supposed to provide a person with a safe environment in which to reflect, explore their feelings, and integrate the difficult and hurtful experience. This idea received support in early studies, which showed that EW can be beneficial for the improvement of psychological and physical health (Smyth, 1998). Furthermore, EW was found to reduce medical visits (Pennebaker and Francis, 1996). Although there is no single and unique underlying mechanism or explanation on how EW leads to improved health, numerous complementary theories, including disinhibition of emotions, cognitive adaptation and reorganization, enhanced emotion regulation, exposure to aversive stimuli, and re-experiencing events and habituation to emotional stimuli, have been proposed to date (Pennebaker and Chung, 2012; Perry and Ward-Smith, 2018; Sabo Mordechay et al., 2019).

Within the past 30 years, there have been numerous studies that assessed if EW is beneficial for physical and mental health. These studies included a broad variety of samples, settings, EW instructions and outcomes, and overall yielded mixed findings. Despite the overall inconsistent results, studies have shown that EW has benefits for mood-related psychological difficulties. Namely, studies have shown that EW reduces depressive symptoms in both general and at-risk populations (Gortner et al., 2006; Sloan et al., 2008). Furthermore, EW has proven beneficial for people reporting high levels of depression and anxiety (Graf et al., 2008).

To systematize this broad and complex literature, several meta-analyses examining the effects of EW have been conducted over the years. Unfortunately, the results were inconclusive even at the meta-analytic level. Namely, an early meta-analysis found an overall positive effect of EW and concluded that it has comparable effects to other psychological treatments (Smyth, 1998). Later, Frisina and colleagues (Frisina et al., 2004) found a small but significant effect for physical health outcomes, but no effect on psychological outcomes. More recently, several meta-analytic studies have not found supporting evidence for the effectiveness of EW for either physical or mental health (Meads and Nouwen, 2005; Mogk et al., 2006; Reinhold et al., 2018), except for the reduction of posttraumatic stress difficulties (Pavlicic et al., 2019). On the contrary, the largest and the most inclusive meta-analysis to date (Frattaroli, 2006) found a significant positive overall effect of EW. More specifically, he found significant average effect for reducing symptoms of depression (unweighted effect size $r = 0.073$), as well as

for distress (unweighted effect size $r = 0.102$) and anxiety (unweighted effect size $r = 0.051$). It is important to note that all these meta-analyses had different study-inclusion criteria and differed in regard to the analytic approach they employed. Looking beyond the inconsistent findings, the meta-analytic studies highlighted the disparity in the quality between the trials and brought to light several important moderating variables that can affect the outcome of the EW intervention.

A close examination of factors contributing to EW efficiency revealed that the more specific the EW intervention is, the greater the chance it will have beneficial results (Reinhold et al., 2018). Moreover, EW was found to be more effective when the number of writing sessions was higher (Frattaroli, 2006; Reinhold et al., 2018), when sessions were longer, and when instructions were more directive, or included a specific writing topic (Reinhold et al., 2018). Some authors discussed the importance of the moderating effect of specificity of writing instructions, since it has been shown that more specific writing instructions are especially valuable for people with certain mental health conditions (e.g., depression), due to which they are experiencing distress as it enables them to adhere to EW requirements more effectively (Baum and Rude, 2013; Rude and Haner, 2018).

Studies exploring individual differences in responsiveness and factors that contribute to the positive effects of EW indicated that participants who perceive their stressful event as more severe benefit more from EW (Greenberg and Stone, 1992). In addition, those who experience moderate severity of negative emotions and are more aware of negative feelings gain the most from EW (Norman et al., 2004; Sabo Mordechay et al., 2019). It seems as if experiencing too many or too few negative feelings can interfere with the underlying processes required for an EW intervention to be beneficial (Sabo Mordechay et al., 2019). Finally, EW intervention group-level effects are stronger when there is a higher percentage of females and a higher mean age of participants in the sample (Reinhold et al., 2018).

Promises of EW in the Context of COVID-19 Pandemic

There is a significant body of evidence to support potential positive effects of EW interventions, and there are various practical benefits of the application of EW in the context of the current COVID-19 pandemic: it can be easily administered, is self-guided, does not require any additional resources, does not present an additional burden for the health system, and can be delivered remotely. EW can be easily adapted for online delivery and has shown positive effects even in an online modality (see Karen et al., 2012). With limited resources and constraints of the health care system during the pandemic, as well as restricted possibilities for the usage of traditional mental health services due to measures for the prevention of COVID-19, the need for cost-effective mental health interventions, such as EW, which could be applied to the large number of people experiencing pandemic-related psychological distress, became even more important.

Current Study

This study aims to assess the effectiveness of EW interventions in the reduction of psychological distress in the general

population during the COVID-19 pandemic by conducting a randomized controlled trial (RCT). We assess if applying a fully remote (online) EW intervention is more effective at reducing psychological distress in the general population than receiving treatment as usual (TAU), which is commonly advised under these circumstances. In addition to measuring effectiveness in the reduction of psychological distress, effects on improving positive aspects of psychological functioning including well-being and satisfaction with quality of life will be assessed. We hypothesized that receiving the EW intervention would be more effective in the reduction of psychological distress and improvement of well-being and satisfaction with quality of life than receiving TAU. If proven to lead to the reduction of psychological distress, EW interventions could be further applied and explored in different settings, including a potential *next wave* of the COVID-19 pandemic, other emergency settings, and in countries in which the health care systems have limited access to mental health care due to specific circumstances (e.g., civic unrest or war) or lack of resources.

MATERIALS AND METHODS

Study Design and Participants

In this parallel-group RCT, participants were recruited through a social media advert. The advert included information regarding the opportunity to be involved in a study assessing the effectiveness of an online intervention aiming to reduce the psychological distress people may experience during the COVID-19 pandemic, and an invitation for potential participants to join the study by signing up online. Those who signed up were provided with a written explanation about the study, activities to be performed, and what would be expected of them if they decide to sign up. Furthermore, potential participants were informed about the inclusion criteria for the study and asked to complete a self-assessed eligibility questionnaire for the following criteria: (a) minimum 18 years of age, (b) native Serbian speaker, and (c) willing to provide informed consent. Eligible participants who decided to participate were then asked to sign an informed consent form and leave an email address to be used for all further correspondence. Those who met the criteria and decided to sign the consent form were contacted by Researcher 1 (MVM) who provided an additional explanation about the study, collected demographic information and COVID-19-related experiences data, and conducted baseline assessments before randomization. This study was approved by the Institutional Ethics Committee (Protocol number #2020-20), and the trial has been registered at ISRCTN registry <https://www.isrctn.com/ISRCTN17898730>.

Randomization and Masking

Participants were randomly allocated (1:1) either to the intervention group—who received the EW intervention—or the control group—who received TAU, i.e., informal support through families, friends, and networks (face-to-face, telephone, and online) as well as support from available services in the community during the state of emergency (e.g., online counseling, hotlines, available self-help manuals). Randomization was performed by Researcher 2 (JB) who used the web-based

system Research Randomizer (Version 4.0) (Urbaniak and Plous, 2013) for random allocation of the participants into two groups. Following the randomization, each participant received a personalized information sheet containing a schedule of the upcoming activities they would be participating in. The group allocation was not disclosed to participants.

Researcher 1, who assessed outcome measures, was also blind to the allocation of participants. Researcher 2, who performed the randomization, was blind to the baseline assessment results. Researcher 3 (SP), who managed the overall supervision of study implementation, was blind to both the outcome measure results and the allocation of participants.

Procedure

The whole trial was conducted online, without any in-person contact between participants and researchers, or among participants. The questionnaires were emailed to participants using an online custom survey platform, and the EW intervention was implemented using the same online platform. Participants allocated to the intervention group were assigned to complete five EW sessions, each lasting 20 min. The EW sessions were set 3 days apart, over a 2 weeks period. Prior to the first session, participants were emailed a brief explanation about EW and their expected engagement. More specifically, the participants were informed about the expected number of EW sessions and the conditions under which they are expected to write (i.e., that they need to be alone in the room, in a place they feel comfortable, to ensure that they have set aside enough time to complete the activity without any distractions, and to shut down all devices and notifications during writing). During each session, participants received the following instruction: *During the next 20 min, write about any experiences and thoughts on your life during the pandemic, write everything that comes to your mind and try to follow your thoughts as they come to you. Feel free to write everything that comes to your mind; don't read back, delete, or change your text, simply write your thoughts, and don't stop for 20 min.* This instruction was visible to participants at all times as they were writing. Participants allocated to the control group received TAU, i.e., informal support through families, friends, and networks. As this trial was conducted under the highly unpredictable and uncontrollable circumstances of the COVID-19 pandemic, we opted for a “natural” control group, i.e., people who were using different available resources to improve their mental health other than EW.

Outcome measures were assessed at three time points—at baseline, post-treatment (a day after the last EW intervention), and follow-up (1-month after the intervention has ended). Information on the number of EW interventions completed by each participant was also registered. Demographic information was collected during the baseline assessment, immediately before randomization, while information about additional support and experiences with the EW intervention was collected during the follow-up assessment.

At the end of the study, all participants were offered to receive feedback based on their baseline and post-assessment results and information on available services offering free psychological support and self-help materials provided by either

the government or specialized institutions/organizations aimed at protection of psychological well-being during the pandemic.

All participants' identifiable data were password-protected and accessible only to Researcher 2. All data were entered into an SPSS database and were anonymized before being shared with other researchers and retrieved for data quality inspection.

Outcomes

The primary outcome was the severity of psychological distress, assessed using DASS 21-Depression Anxiety Stress Scale, short version (Osman et al., 2012), measured at post-treatment. Secondary outcomes assessed at post-treatment were severity of depression-related psychological distress, assessed using DASS 21 depression subscale; anxiety-related psychological distress, assessed using DASS 21 anxiety subscale; stress-related psychological distress, assessed using DASS 21 stress subscale; well-being, assessed using the WHO well-being index; and subjective perception of the quality of life, assessed using the SQOL, the mean score of the 12 satisfaction items from the Manchester Short Assessment of Quality of Life (MANSA) (Priebe et al., 1999). DASS 21 was selected as a primary outcome for several reasons. First, it enables the capture of the most prominent difficulties that can be expected in a pandemic—depression, anxiety, and stress. Furthermore, this instrument has good psychometric properties with internal consistency >0.85 (Cronbach's alpha), which tends to be stable across different countries i.e., Greece (Lyrakos et al., 2011), Turkey (Zanan and Nuran, 2010), Nigeria (Coker et al., 2018), Vietnam (Le et al., 2017), Brazil (Batistelli Vignolaa and Marcassa Tucci, 2014), etc. The Serbian version of DASS21 showed high validity and reliability with internal consistency coefficients, i.e., Cronbach's alpha = 0.87, 0.82, and 0.86 for depression, anxiety, and stress, respectively (Batistelli Vignolaa and Marcassa Tucci, 2014). Moreover, this instrument was selected as it can be administered online for both clinical and research purposes (Lovibond and Lovibond, 1995). Finally, due to the fact that DASS 21 does not measure traits, but psychological states, it can be expected to validly capture changes in one's emotional state over a relatively short period of time (Lovibond and Lovibond, 1995). In addition to DASS 21, we used MANSA to capture positive aspects of psychological functioning. MANSA has good psychometric properties, considering it is a brief measure (Cronbach's alpha = 0.74), and a high correlation with subjective quality of life assessments (Priebe et al., 1999).

In addition to the outcome measures, basic demographic information, satisfaction with social support including satisfaction with personal relationships and satisfaction with support of friends (Atroszko et al., 2015), and information on COVID-19-related experiences (e.g., if they or members of their family are diagnosed with COVID-19, if they were experiencing symptoms, etc.) were collected at baseline. Data regarding potential usage of any other psychosocial support services (e.g., online counseling, reading self-help manuals and guidance on how to cope during the state of emergency, social media blogs on emotion regulation, etc.) were collected at both post-treatment and the follow-up assessment. Finally, at the follow-up assessment, participants from the intervention

group were asked about their experiences related to the EW intervention: (1) if they felt as if it was useful and (2) if it was too much of a burden.

Statistical Analyses

The sample size was determined using G*Power 3.1 software with the expected effect sizes (η^2 of 0.06 and the power of 0.80 in respect to planned statistical analysis-ANCOVA). This expectation about the effect size was based on previous EW studies (Mogk et al., 2006; Pavlacic et al., 2019; Reinhold et al., 2018). The statistical analysis plan was defined before unblinding the data or conducting any analysis, and all statistical analyses were carried out in line with the statistical analysis plan. All analyses were done using IBM SPSS Statistics for Windows, Version 22.0. Post-treatment outcomes were compared using general linear models, adjusting for the baseline score of the given outcome, i.e., analysis of covariance (ANCOVA). For post-treatment outcome, variables at post-treatment were entered as dependent, GROUP (EW vs. TAU) was a between-subject factor, and baseline score was entered as a covariate to control for individual differences at baseline. Follow-up data were analyzed in the same manner with outcome score at 1-month follow-up as the independent variable. Finally, to assess the effects of personal characteristics that could moderate the effects, we performed interaction analysis (GROUP \times GENDER; GROUP \times AGE GROUP) with baseline-to-post-treatment change score as a dependent variable. All analyses were done with available cases only. Given the exploratory nature of the study, per protocol analysis included only participants who completed treatment, defined as completing a minimum of four out of five EW sessions, while excluding participants based on the following criteria: if they experienced the death of a family member or close friend during the trial, and if they were experiencing severe mental health distress, defined as scoring 3 SD above average on the DASS at either the pre- or post-test. Significance testing was set at the 5% level, across all analyses.

RESULTS

During the recruitment period (7 to 14 of April), 150 participants signed up for the study, out of which 120 were randomized across EW and TAU groups. Complete data at post-treatment were obtained for 104 participants while 74 participants were assessed at follow-up (Figure 1).

Demographic characteristics were balanced between the EW and control groups (Table 1). There were more female than male participants in both groups. All participants were symptom-free and not tested for COVID-19, while very few had had close contact (i.e., family members or close friends) with confirmed COVID-19 contagion (five in the treatment group and three in the control group). All demographic and COVID-related information about the sample is presented in Table 1.

Primary outcome data were available for 104 participants-48 participants in the treatment group and 56 participants in the control group. All primary and secondary outcome measures at all time points are summarized in Table 2. The comparison

between baseline and post-treatment in the treatment group shows no difference in the primary outcome. The only statistically significant effect was observed in post-treatment stress level (Table 3). In contrast, in the control group, no differences were observed for any of the outcome measures between baseline and post-treatment. The baseline-to-follow-up comparison showed significant differences in primary outcome in both the treatment and control groups. For the secondary outcome measures, baseline-to-follow-up differences were observed for depression in both the treatment and control groups, as well as stress in the treatment group. The changes and the correlations between baseline and post-treatment as well as between baseline and follow-up for both primary and secondary outcomes are presented in Table 3.

The ANCOVA for treatment versus control group on primary outcome, i.e., post-test DASS total scores, controlling for baseline DASS score was found to have a statistically significant main effect of group $F(1,101) = 5.600$, $p = 0.020$, $p\eta^2 = 0.053$. There was a significant effect of treatment on post-test stress after controlling for stress at baseline $F(1,101) = 16.360$, $p = 0.000$, $p\eta^2 = 0.139$, with the treatment group scoring higher on both measures. A main effect of group on post-test Depression and Anxiety, after controlling for baseline scores, was not found: $F(1,101) = 3.078$, $p = 0.082$, $p\eta^2 = 0.030$ and $F(1,101) = 0.115$, $p = 0.735$, $p\eta^2 = 0.001$, respectively. A main effect of group on Well-being and Subjective quality of life post-test scores, when controlling for baseline scores on these scales, was not found either: $F(1,101) = 1.276$, $p = 0.261$, $p\eta^2 = 0.012$ and $F(1,101) = 0.352$, $p = 0.554$, $p\eta^2 = 0.003$ respectively. The ANCOVA for treatment versus control group on post-test measure of having a hard time making it through the coronavirus pandemic and state of emergency, when controlling for baseline score on this measure, showed a significant group effect, with the treatment group scoring significantly higher than the control group $F(1,101) = 6.813$, $p = 0.010$, $p\eta^2 = 0.063$.

The ANCOVA for EW versus TAU group on follow-up outcome measures revealed no statistically significant main group effect when controlling for baseline scores. Specifically, no effect was found for DASS total score, $F(1,71) = 0.087$, $p = 0.769$, $p\eta^2 = 0.001$, Depression, $F(1,71) = 0.025$, $p = 0.874$, $p\eta^2 = 0.000$, Anxiety, $F(1,71) = 0.416$, $p = 0.521$, $p\eta^2 = 0.006$, and Stress subscales, $F(1,71) = 0.001$, $p = 0.970$, $p\eta^2 = 0.000$, Well-being, $F(1,71) = 0.174$, $p = 0.678$, $p\eta^2 = 0.002$, and Subjective quality of life, $F(1,71) = 0.691$, $p = 0.408$, $p\eta^2 = 0.010$.

Per protocol analysis resulted in the exclusion of seven participants from the treatment group based on treatment compliance as well as four participants from the experimental and three participants from the control group based on other criteria. Following the exclusion of 14 participants, we reran the analysis on post-treatment outcomes. Most of the results stayed the same, except for the effect on depression, which reached the significance threshold. Results of the complete, per protocol analysis are shown in Supplementary Material.

To explore the factors contributing to the outcome of the intervention, we calculated the CHANGE score for the

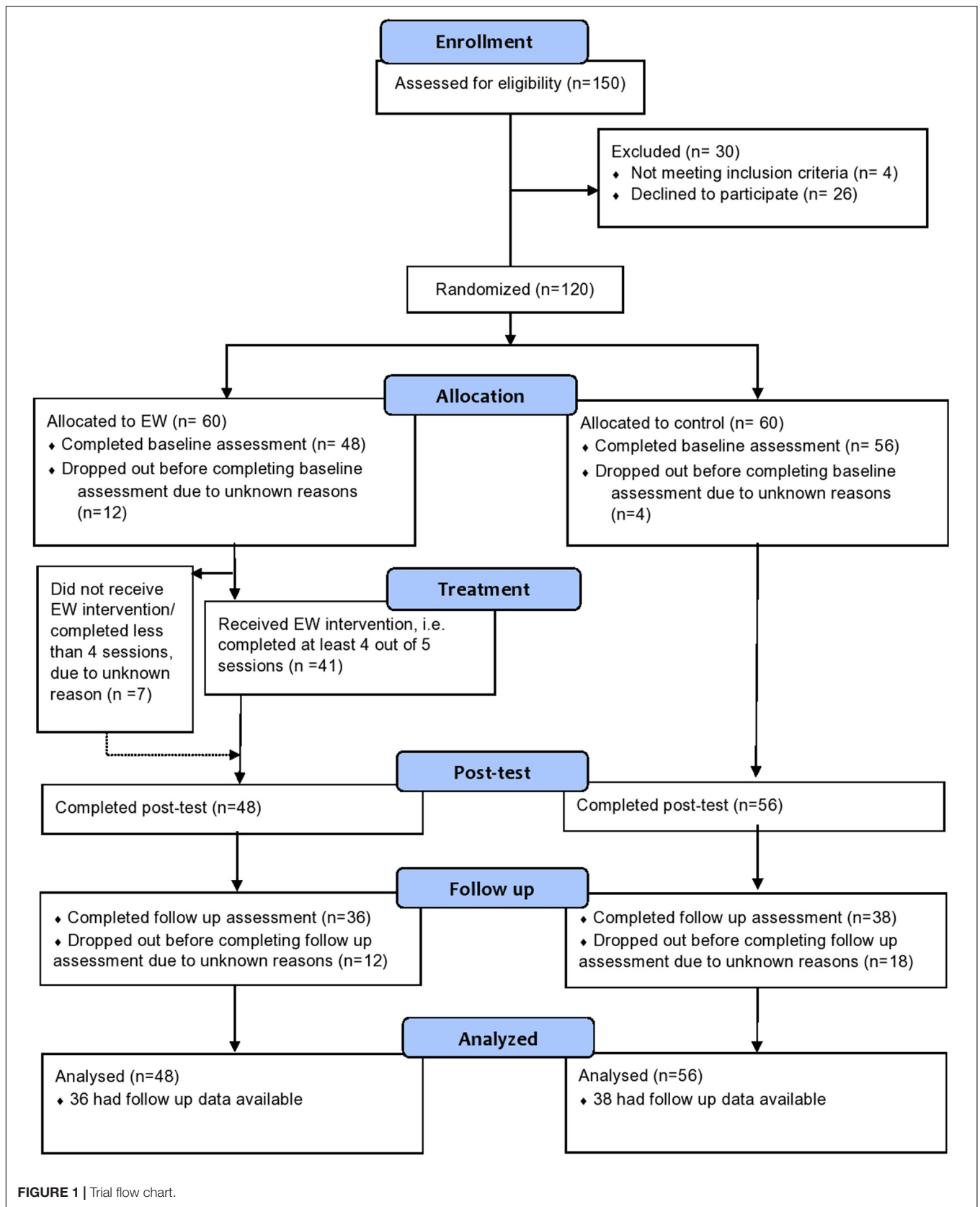


FIGURE 1 | Trial flow chart.

TABLE 1 | Demographic characteristics of the sample.

Variable	Treatment	Control
Gender		
Male [%]	23%	30%
Female [%]	77%	70%
Age [years; mean (SD)]	31.79 (9.062)	32.67 (10.848)
Education [years; mean (SD)]	15.69 (3.088)	15.75 (2.480)
Do you have a chronic illness?		
Yes [%]	21	7
No [%]	67	84
Not sure [%]	2	4
Are you doing a job that requires you to be physically in contact/close to more than a few people?		
Yes [%]	49	30
No [%]	51	70
Are you working in the health sector (e.g., as a nurse, medical doctor, etc.)?		
Yes [%]	2	2
No [%]	98	98
Are you at risk of losing your job or experiencing a significant decrease in income?		
Yes [%]	35	36
No [%]	65	64
Are you or have you been infected with the novel coronavirus?		
Yes [%]	0	0
No [%]	100	100
Have members of your family or your close friends been infected with the novel coronavirus?		
Yes [%]	16	11
No [%]	88	89
How satisfied are you with your personal relationships? [9-point scale; mean (SD)]	6.95 (1.786)	7.36 (1.545)
How satisfied are you with the support you get from your friends? [9-point scale; mean (SD)]	7.58 (1.367)	7.71 (1.513)
How would you rate your knowledge level on the novel coronavirus? [9-point scale; mean (SD)]	6.47 (1.609)	6.55 (1.449)
How would you rate your knowledge level on how to prevent the spread of the novel coronavirus? [9-point scale; mean (SD)]	7.70 (1.036)	7.94 (1.406)
What is your probability of getting infected with the novel coronavirus? [9-point scale; mean (SD)]	4.42 (1.562)	3.77 (1.579)
How susceptible do you consider yourself to a novel coronavirus infection? [9-point scale; mean (SD)]	4.79 (1.833)	4.28 (2.051)
I follow the recommendations from authorities in my country to prevent spread of novel coronavirus. [9-point scale; mean (SD)]	8.44 (0.796)	8.36 (1.128)
Usage of psychological support or counseling services		
Yes [%]	21	9
No [%]	54	59
No response [%]	25	32
Usage of self-help psychosocial support services (e.g., reading self-help manuals and guidance on how to cope during the state of emergency, social media blogs on emotion regulation, etc.)		
Yes [%]	17	2
No [%]	58	66
No response [%]	25	32

main outcome measure (e.g., $DASS_{change} = DASS_{post} - DASS_{pre}$), for which positive values indicate elevated symptoms and negative values indicate reduced symptoms. To assess if the change in the main outcome (DASS total score change) was different between the experimental and control groups depending on characteristics of the participants, we performed a series of interaction analyses-ANOVAs with DASS total score change as dependent variable and GROUP (treatment vs control) with GENDER (male vs. female) or AGE GROUP (younger vs. older; median split at 30 years with younger being those aged 30 and less) as predictors.

A significant $GROUP \times GENDER$ interaction effect was observed, $F(1,92) = 6.989$, $p = 0.010$, $p\eta^2 = 0.071$, as well as a $GROUP \times AGE$ GROUP interaction, $F(1,100) = 7.682$, $p = 0.007$, $p\eta^2 = 0.071$, indicating that EW interventions may be particularly counterproductive for older and male participants (**Figure 2**).

After the follow-up assessment, EW group participants were invited to share their perceptions and experiences of the intervention. Two-thirds of participants reported that participating in EW was beneficial for them personally. Only 6 out of 36 participants reported the EW intervention being time-consuming and difficult to complete.

TABLE 2 | Descriptive statistics for primary and secondary outcomes for treatment and control groups across baseline, post-treatment, and follow-up.

Outcomes	Treatment						Control					
	Baseline (N = 48)		Post-treatment (N = 48)		Follow-up (N = 36)		Baseline (N = 56)		Post-treatment (N = 56)		Follow-up (N = 38)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
DASS (Tot)	22.04	15.139	22.46	12.881	15.61	12.838	15.84	11.747	14.21	11.972	13.24	9.733
Depr (DASS)	6.21	5.750	6.25	5.105	3.83	4.339	4.66	4.837	4.05	4.534	3.55	4.065
Anxiety (DASS)	5.69	5.654	4.65	4.970	3.56	4.925	2.93	3.879	2.93	4.276	2.29	2.779
Stress (DASS)	10.15	5.986	11.56	5.124	8.22	5.509	8.25	4.944	7.23	5.250	7.39	5.405
WHO	3.13	0.844	3.16	0.863	3.35	0.816	3.14	0.822	3.29	0.829	3.26	0.842
SQOL	4.90	1.032	4.89	1.070	4.98	1.022	4.99	1.149	5.03	1.126	4.94	1.295
Hard time making it through the pandemic	2.08	1.007	2.19	1.065	–	–	1.696	0.761	1.57	0.759	–	–

TABLE 3 | The changes and the correlations between baseline and posttreatment and baseline and follow up for both primary and secondary outcomes.

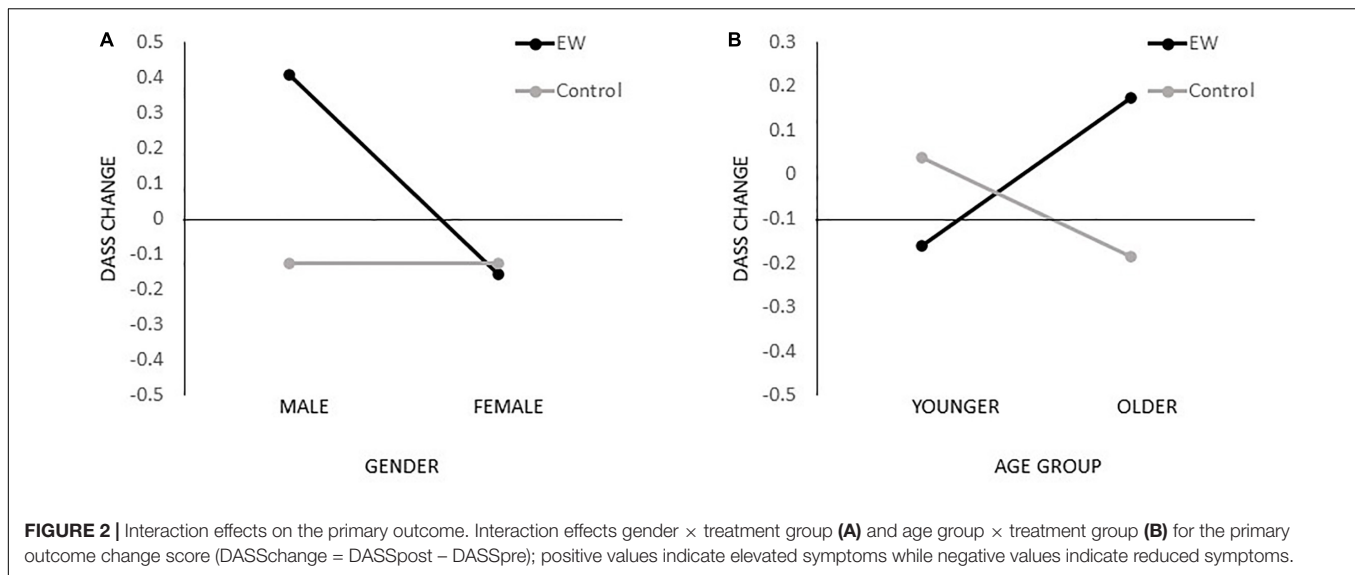
Outcomes	Treatment				Control			
	Baseline – Post treatment (N = 48)		Baseline – Follow – up (N = 36)		Baseline – Post – treatment (N = 56)		Baseline – Follow – up (N = 38)	
	Difference	r	Difference	r	Difference	r	Difference	r
DASS total	$t(47) = -0.235,$ $p = 0.815$	0.628	$t(35) = 2.398,$ $p = 0.022$	0.528	$t(55) = 1.244,$ $p = 0.219$	0.661	$t(37) = 2.115,$ $p = 0.041$	0.488
Depression (DASS)	$t(47) = -0.058,$ $p = 0.954$	0.580	$t(35) = 2.242,$ $p = 0.031$	0.529	$t(55) = 1.253,$ $p = 0.216$	0.702	$t(37) = 2.651,$ $p = 0.012$	0.588
Anxiety (DASS)	$t(47) = 1.349,$ $p = 0.184$	0.499	$t(35) = 1.946,$ $p = 0.060$	0.443	$t(55) = 0.000,$ $p = 1.000$	0.618	$t(37) = 1.467,$ $p = 0.151$	0.391
Stress (DASS)	$t(47) = -2.290,$ $p = 0.027^*$	0.713	$t(35) = 2.078,$ $p = 0.045$	0.617	$t(55) = 1.766,$ $p = 0.083$	0.644	$t(37) = 1.330,$ $p = 0.192$	0.536
Well-being (WHO)	$t(47) = -0.338,$ $p = 0.737$	0.755	$t(35) = -1.983,$ $p = 0.055$	0.615	$t(55) = -1.874,$ $p = 0.066$	0.711	$t(37) = -1.849,$ $p = 0.072$	0.653
SQOL	$t(47) = -0.165,$ $p = 0.870$	0.806	$t(35) = -0.294,$ $p = 0.770$	0.794	$t(55) = -0.449,$ $p = 0.655$	0.757	$t(37) = 0.962,$ $p = 0.342$	0.854
Hard time making it through the pandemic	$t(47) = -0.658,$ $p = 0.514$	0.441			$t(55) = -1.308,$ $p = 0.196$	0.557		

DISCUSSION

This study assessed the effectiveness of a fully remote EW intervention in the reduction of psychological distress and improvement of well-being and satisfaction with the quality of life in the general population in the context of the COVID-19 pandemic. Our study found no evidence that five sessions of remote EW generate benefits in lowering depression, anxiety, and stress, and increasing overall well-being. On the contrary, our results showed that engaging in EW during the pandemic elevates the stress level of participants from the intervention group. The same results were obtained when controlling for the baseline results. Results of the follow-up assessment indicated that the severity of depressive and overall psychological distress measured by DASS total score decreased in both groups; however, no differences between groups were obtained. These results indicate that participation in the EW intervention did not have long-term effects. Per protocol analysis, which resulted in the exclusion of 14 participants, revealed similar results, with additional identified effects of EW on evaluated symptoms of

depression in the treatment group. Finally, results indicated that EW intervention under these specific circumstances may be particularly counterproductive for older and male participants.

The rationale behind assessing the effectiveness of EW intervention was that, in the context of the pandemic, many people without a previous history of psychosocial difficulties may experience fear, anxiety, and depression. Moreover, the pandemic made access to mental health care more difficult as many primary health care institutions were either transformed into COVID-19 units or had to change the way they operate to comply with measures aiming to contain and limit the spread of the disease. Therefore, the current pandemic requires additional mental health care for the increased number of people in need and, at the same time, puts constraints on how psychosocial support can be provided. Hence, interventions like EW, which can be performed remotely and could address the needs of a large number of people with existing resources, seem a promising path to tackle this issue. Still, some limitations to our study need to be pointed out. First, the intervention aimed to tackle the need for mental health care in the general population, but



recruitment was not limited to those seeking support. Moreover, the number of participants in the trial was not large, due to the relatively short recruitment period, which was essential in order to minimize the effects of contextual factors and rapid changes during a pandemic. Furthermore, it has to be highlighted that the control condition, despite being a “natural” control, was a highly heterogeneous group to contrast EW intervention due to the pandemic context. Finally, this study assessed only one possible direction for EW; thus, the evidence in this paper is limited to the specific instruction for EW that was presented to the participants. Nevertheless, this study, to the best of our knowledge, is the first to assess the effects and the applicability of an EW intervention in the context of the current COVID-19 pandemic.

To understand the effects of the EW intervention, it is important to note that the circumstances under which it was performed could have altered/affected the mechanisms involved in previously reported beneficial effects of EW. Namely, in the vast majority of prior studies, the EW was conducted either after or in absence of a specific traumatic or stressful event. In contrast, in this study, EW was performed at a moment when the stressor was and still is present, without available and reliable information on when it is expected to end. Thus, it is possible that potential integration of experiences, cognitive adaptation, and reorganization or enhanced emotion regulation required for beneficial effects of EW was disrupted under these circumstances. Furthermore, engaging in EW during a stressful event could lead to focusing one’s attention on pandemic-related content and expectations, thus increasing awareness of the potential threat and/or exaggerating the likelihood of negative outcomes. If this is the case, EW interventions could function as rumination or emotional ventilation, which have been shown to be maladaptive mechanisms for coping with stress and trauma (Littleton et al., 2007). Studies exploring the relationship between rumination style and the effects of EW on the reduction of depressive symptoms showed that some ruminative styles moderate effects of EW on depressive symptoms (Sloan et al., 2008). Therefore, it

is possible that elevated stress levels following the EW could be attributed to the timing of the intervention.

The second question is content or the topic of EW. In this study, the instruction for EW was to focus on thoughts and feelings related to pandemic. We opted for focusing the EW prompt on pandemic-related experiences, since previous studies showed that EW interventions with more specific instructions had a higher chance of producing positive results (Reinhold et al., 2018). On the other hand, as some authors discussed, participants’ motivation to engage in EW and their need for intervention are fundamental requirements upon which the effectiveness of EW depends (Rude and Haner, 2018). In the context of pandemic, which is undoubtedly stressful, it is possible that some people were not motivated or did not have a need for additional intervention as they were coping with the pandemic through avoidance of pandemic-related thoughts or by having supportive social relationships in which they were already emotionally expressive, and thus experienced EW as additional exposure to a source of distress. Thus, the increased levels of stress observed in our study could be the result of additional exposure to already widely present pandemic-related content that does not allow enough time for habituation and can interfere with the alternation of intrusion and avoidance, which characterizes natural processing of stressful or traumatic events (Van Emmerik et al., 2002). As our study design does not allow for inference on the effects of the specificity of the EW instruction, future research should explore if the EW intervention would be beneficial if focused on the content not related to the source of distress, or if focused on life after the stressful events are over.

Moreover, our data suggest that EW, when administered online, may not be equally appealing to different age and gender groups. Specifically, the increased stress was recorded among men and among those of age ≥ 30 years. One could argue that these differences could be attributed to different levels of digital literacy, but we do not believe that is the case here. Namely, it is more likely that digital literacy presents a limiting factor

to population-wide implementation of any online interventions and that for those who volunteer to participate in online mental health interventions, the online format does not represent a barrier. It is more likely that age and gender play an important role in how natural and appealing they perceive EW to be and consequently how engaging and immersive they find it. In line with that, previous studies found that participants' characteristics and individual differences (Sabo Mordechay et al., 2019), as well as mental health status (Pavlicic et al., 2019), moderate the effects of EW. Therefore, the negative effects of EW on some of the outcome variables obtained at the group level could be attributed to rather broad inclusion criteria for participants and, more specifically, to negative effects on certain subgroups of participants.

It should, however, be noted that despite not leading to symptom relief, the majority of participants from the intervention group in our study reported that the experience of participating in the research was personally useful to them. Similarly, as in a study by Lange-Nielsen and colleagues (Lange-Nielsen et al., 2012), although it did not result in a measurable improvement in health, participants who went through the EW intervention found that experience a meaningful process. These insights and beneficial experiences reported by participants should not be overlooked either. As stated by some authors, "feeling better" during the disaster should not be taken for granted and should be considered a desirable outcome irrespective of any longer-term benefits (Wessely and Deahl, 2003).

Therefore, our study does not necessarily suggest abandonment of EW interventions as such, but rather recommends tailoring specific EW intervention modalities in accordance with individual needs, and using EW interventions as a part of a comprehensive stress management approach. EW may help people to better understand a stressful experience, be mentally prepared for the trauma-related difficulties, or prevent rumination (Kleim et al., 2015; Sloan et al., 2008). However, its usage as a stand-alone intervention for the reduction of psychological distress during pandemic was not supported by our study.

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

We assessed the effectiveness of a 2 week EW intervention for the reduction of depression, anxiety, and stress symptoms in the general population during the COVID-19 pandemic. Despite EW being recognized as a beneficial intervention in a variety of different settings, our trial showed that, when applied in the context of the COVID-19 pandemic, not only does it not benefit one's mental health, but it may actually be harmful and lead to increased symptoms of stress. Our trial suggests that EW may be particularly harmful to older and male participants. Our data strongly indicate that one should be highly cautious when applying EW or similar self-guided interventions in novel contexts, especially during highly stressful and unpredictable times. It might be the case that under such circumstances,

clinical supervision and guidance are necessary for EW to be effective. Furthermore, considering individual differences and the motivation to participate in this type of intervention may result in a more selective but effective approach to remedy pandemic-related stress. Finally, it is worth assessing how differently directed EW interventions may prove to be more efficient.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Committee of the Department of Psychology, Faculty of Philosophy, University of Belgrade Protocol number 2020/20. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the conception and the design of this work. MV and JB collected and analyzed the data. MV drafted the manuscript. JB and SP critically reviewed and revised the manuscript. All authors read and approved the final version submitted for publishing.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.587282/full#supplementary-material>

REFERENCES

- Andersson, M. A., and Conley, C. S. (2013). Optimizing the perceived benefits and health outcomes of writing about traumatic life events. *Stress Health* 29, 40–49. doi: 10.1002/smi.2423
- Atroszko, P., Pianka, L., Raczynska, A., Sektas, M., and Atroszko, B. (2015). Validity and reliability of single-item self-report measure of social support. *Comp. Eur. Res.* 101–104.
- Batistelli Vignola, R. C., and Marcassa Tucci, A. (2014). Adaptation and validation of the depression, anxiety and stress scale (DASS) to Brazilian Portuguese. *J. Affect. Disord.* 155, 104–109.
- Baum, E. S., and Rude, S. S. (2013). Acceptance-enhanced expressive writing prevents symptoms in participants with low initial depression. *Cogn. Ther. Res.* 37, 35–42. doi: 10.1007/s10608-012-9435-x
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8
- Choi, E. P. H., Hui, B. P. H., and Wan, E. Y. F. (2020). Depression and anxiety in Hong Kong during covid-19. *Int. J. Environ. Res. Public Health* 17:3740. doi: 10.3390/ijerph17103740
- Coker, A. O., Coker, O. O., and Sanni, D. (2018). Psychometric properties of the 21-item depression anxiety stress scale (DASS-21). *Afr. Res. Rev.* 12, 135–142.
- Ettman, C. K., Abdalla, S. M., Cohen, G. H., Sampson, L., Vivier, P. M., and Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 Pandemic. *JAMA Netw. Open* 3:e2019686. doi: 10.1001/jamanetworkopen.2020.19686
- Frattaroli, J. (2006). Experimental disclosure and its moderators: a meta-analysis. *Psychol. Bull.* 132, 823–865. doi: 10.1037/0033-2909.132.6.823
- Frisina, P. G., Borod, J. C., and Lepore, S. J. (2004). A meta-analysis of the effects of written emotional disclosure on the health outcomes of clinical populations. *J. Nervous Ment. Dis.* 192, 629–634. doi: 10.1097/01.nmd.0000138317.30764.63
- Gortner, E. M., Rude, S. S., and Pennebaker, J. W. (2006). Benefits of expressive writing in lowering rumination and depressive symptoms. *Behav. Ther.* 37, 292–303. doi: 10.1016/j.beth.2006.01.004
- Graf, M. C., Gaudiano, B. A., and Geller, P. A. (2008). Written emotional disclosure: a controlled study of the benefits of expressive writing homework in outpatient psychotherapy. *Psychother. Res.* 18, 389–399.
- Greenberg, M. A., and Stone, A. A. (1992). Emotional disclosure about traumas and its relation to health: effects of previous disclosure and trauma severity. *J. Personal. Soc. Psychol.* 63, 75–84. doi: 10.1037/0022-3514.63.1.75
- Karen, A., Geerligsa, B. L., and Kay, W. (2012). Expressive writing and positive writing for participants with mood disorders: an online randomized controlled trial. *J. Affect. Disord.* 136, 310–319.
- Kleim, B., Bingisser, M. B., Westphal, M., and Bingisser, R. (2015). Frozen moments: flashback memories of critical incidents in emergency personnel. *Brain Behav.* 5, 1–8. doi: 10.1002/brb3.325
- Lange-Nielsen, I. I., Kolltveit, S., Thabet, A. A. M., Dyregrov, A., Pallesen, S., Johnsen, T. B., et al. (2012). Short-term effects of a writing intervention among adolescents in Gaza. *J. Loss Trauma* 17, 403–422. doi: 10.1080/15325024.2011.650128
- Le, M. T. H., Tran, T. D., Holton, S., Nguyen, H. T., Wolfe, R., and Fisher, J. (2017). Reliability, convergent validity and factor structure of the DASS-21 in a sample of vietnamese adolescents. *PLoS One* 12:e0180557. doi: 10.1371/journal.pone.0180557
- Littleton, H., Horsley, S., John, S., and Nelson, D. V. (2007). Trauma coping strategies and psychological distress: a meta-analysis. *J. Traumatic Stress* 20, 977–988. doi: 10.1002/jts
- Lovibond, S. H., and Lovibond, P. F. (1995). *Manual for the Depression Anxiety & Stress Scales*, 2nd Edn. Sydney: Psychology Foundation.
- Lyrakos, G. N., Arvaniti, C., Smyrnioti, M., and Kostopanagioto, G. (2011). Translation and validation study of the depression anxiety stress scale in the greek general population and in a psychiatric patient's sample. *Eur. Psychiatry* 26:1731.
- Meads, C., and Nouwen, A. (2005). Does emotional disclosure have any effects? A systematic review of the literature with meta-analyses. *Int. J. Technol. Assess. Health Care* 21, 153–164. doi: 10.1017/s026646230505021x
- Mogk, C., Otte, S., Reinhold-Hurley, B., and Kröner-Herwig, B. (2006). Health effects of expressive writing on stressful or traumatic experiences - a meta-analysis. *Psycho Soc. Med.* 3:Doc06.
- Norman, S. A., Lumley, M. A., Dooley, J. A., and Diamond, M. P. (2004). For whom does it work? moderators of the effects of written emotional disclosure in a randomized trial among women with chronic pelvic pain. *Psychos. Med.* 66, 174–183. doi: 10.1097/01.psy.0000116979.77753.74
- Osman, A., Wong, J. L., Bagge, C. L., Freedenthal, S., Gutierrez, P. M., and Lozano, G. (2012). The depression anxiety stress scales-21 (DASS-21): further examination of dimensions, scale reliability, and correlates. *J. Clin. Psychol.* 68, 1322–1338. doi: 10.1002/jclp.21908
- Pavlicic, J. M., Buchanan, E. M., Maxwell, N. P., Hopke, T. G., and Schulenberg, S. E. (2019). A meta-analysis of expressive writing on posttraumatic stress, posttraumatic growth, and quality of life. *Rev. Gen. Psychol.* 23, 230–250. doi: 10.1177/1089268019831645
- Pennebaker, J. W., and Chung, C. K. (2012). “Expressive writing: connections to physical and mental health,” in *The Oxford Handbook of Health Psychology*, ed. H. S. Friedman (Oxford: Oxford University Press), 78712. doi: 10.1093/oxfordhb/9780195342819.013.0018
- Pennebaker, J. W., and Francis, M. E. (1996). Cognitive, emotional, and language processes in disclosure. *Cogn. Emot.* 10, 601–626. doi: 10.1080/026999396380079
- Perry, J. A., and Ward-Smith, P. (2018). Expressive writing as an intervention to decrease distress in pediatric critical care nurses. *Clin. Nurs. Stud.* 6:96. doi: 10.5430/cns.v6n3p96
- Priebe, S., Huxley, P., Knight, S., and Evans, S. (1999). Application and results of the manchester short assessment of quality of life (MANSA). *Int. J. Soc. Psychiatry* 45, 7–12. doi: 10.1177/002076409904500102
- Reinhold, M., Bürkner, P. C., and Holling, H. (2018). Effects of expressive writing on depressive symptoms-A meta-analysis. *Clin. Psychol.* 25, 1–13. doi: 10.1111/p.12224
- Rude, S. S., and Haner, M. L. (2018). Individual differences matter: commentary on “Effects of expressive writing on depressive symptoms-A meta-analysis.”. *Clin. Psychol.* 25, 1–5. doi: 10.1111/cpsp.12230
- Sabo Mordechay, D., Nir, B., and Eviatar, Z. (2019). Expressive writing - Who is it good for? Individual differences in the improvement of mental health resulting from expressive writing. *Comp. Ther. Clin. Pract.* 37, 115–121. doi: 10.1016/j.ctcp.2019.101064
- Sloan, D. M., Marx, B. P., Epstein, E. M., and Dobbs, J. L. (2008). Expressive writing buffers against maladaptive rumination. *Emotion* 8, 302–306. doi: 10.1037/1528-3542.8.2.302
- Smyth, J. M. (1998). Written emotional expression: effect sizes, outcome types, and moderating variables. *J. Consult. Clin. Psychol.* 66, 174–184. doi: 10.1037/0022-006X.66.1.174
- Urbaniaik, G. C., and Plous, S. (2013). *Research Randomizer (Version 4.0)*.
- Van Emmerik, A. A. P., Kamphuis, J. H., Hulsbosch, A. M., and Emmelkamp, P. M. G. (2002). Single session debriefing after psychological trauma: a meta-analysis. *Lancet* 360, 766–771. doi: 10.1016/S0140-6736(02)09897-5
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17, 1–25. doi: 10.3390/ijerph17051729
- Wessely, S., and Deahl, M. (2003). Psychological debriefing is a waste of time. *Br. J. Psychiatry* 183, 12–14. doi: 10.1192/bjp.183.1.12
- Xiang, Y. T., Yang, Y., Li, W., Zhang, L., Zhang, Q., Cheung, T., et al. (2020). Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *Lancet Psychiatry* 7, 228–229. doi: 10.1016/S2215-0366(20)3046-8
- Zanan, B., and Nuran, B. (2010). Turkish version of the depression, anxiety and stress scale; psychometric properties. *Arch Neuropsychiat* 47, 118–126.

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The Influence of Personality, Resilience, and Alexithymia on Mental Health During COVID-19 Pandemic

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Following the COVID-19 pandemic, many countries worldwide have put lockdowns in place to prevent the virus from spreading. Evidence shows that lockdown measures can affect mental health; it is, therefore, important to identify the psychological characteristics making individuals more vulnerable. The present study aimed, first, to identify, through a cluster analysis, the psychological attributes that characterize individuals with similar psychological responses to the COVID-19 home confinement; second, to investigate whether different psychological characteristics, such as personality traits, alexithymia, and resilience, specifically influence anxiety, stress, and depression, depending on the scope of the confinement. We analyzed data from 393 participants who completed an online survey on their experiences during two different phases of the Italian lockdown, characterized by more or less strict measures of confinement. Two clusters were identified which included participants reporting a better (+ER) and worse (–ER) emotional response to the lockdown, respectively. Individuals in the –ER group showed lower emotional stability, resilience, and higher alexithymia. Moreover, even if lifting part of the restrictions decreased psychological distress among all participants, a reduction in perceived stress was observed only among individuals with high resilience. Finally, personality traits, alexithymia, and resilience differently affected depression, anxiety, and stress. Our results suggest that different psychological interventions should be planned depending on the context: mental health professionals should focus on enhancing the individuals' coping strategies to alleviate stress in emergencies, while long-term intervention aiming at alleviating anxiety and depressive symptoms should focus on alexithymic tendencies and personality constructs.

Keywords: COVID-19 pandemic, lockdown, mental health – state of emotional and social well-being, resilience (psychological), personality, alexithymia (TAS-20)

INTRODUCTION

In early 2020 COVID-related restrictions forced people to stay home, in social isolation, blocking daily activities for months. This dramatic context triggered critical psychological consequences, such as anxiety, stress, depression, frustration, irritability, insomnia, post-traumatic stress symptoms, and anger (Brooks et al., 2020; Di Giuseppe et al., 2020; Franceschini et al., 2020; Salari et al., 2020). Studies from different countries showed that the incidence of these psychological problems was high everywhere: for example, surveys on Chinese respondents showed that almost 35% of the participants experienced psychological distress (Qiu et al., 2020) and that 2.9% scored above the cut-off for post-traumatic stress disorder (PTSD) and 9% scored at or above the clinical cut-off for depression (Tang et al., 2020). In another survey, including mostly participants from the United States and Israel, 22.2% of the population met the threshold for generalized anxiety, and 16.1% for generalized depression (Barzilay et al., 2020). In the Italian population, it was reported that around 20% of participants of a survey distributed during the first weeks of the lockdown experienced depression, anxiety, or high perceived stress, and 37% experienced post-traumatic stress symptoms (Rossi et al., 2020) while another study reported that 20% of the general population reported post-traumatic stress symptoms (Castelli et al., 2020). Similar percentages were reported in the general Italian population also by Mazza et al. (2020a) and Landi et al. (2020). A meta-analysis on the effects of the pandemic worldwide published in July 2020 indicated that the prevalence of stress was 29.6% (five studies, 9,074 participants), the prevalence of anxiety was 31.9% (17 studies, 63,439 participants), and that of depression was 33.7% (14 studies, 44,531 participants; Salari et al., 2020). Another systematic review confirmed high rates of symptoms of anxiety, depression, post-traumatic stress disorder, and stress in the general population during the COVID-19 pandemic in China, Spain, Italy, Iran, the United States, Turkey, Nepal, and Denmark (Xiong et al., 2020).

Among the psychological dimensions that mediate the relationship between stressors and mental health outcomes during lockdowns, an important role is played by individual differences in personality traits (Segerstrom and Smith, 2019), resilience and coping strategies (Serafini et al., 2020), and alexithymia (Hua et al., 2014). With regard to personality, one of the most accepted and used models is the five-factor model, or the big five (Goldberg, 1990), which includes emotional stability (also referred to as neuroticism), extraversion, openness, agreeableness, and conscientiousness. Openness, neuroticism, and extraversion, in particular, have been shown to influence the response to stress: for example, Oswald et al. (2006) found that self-reported Openness (the disposition to be inventive/curious, as opposed to being consistent/cautious) directly correlated with cortisol responses to stress. Schneider et al. (2012) found that during a stressful task, participants' neuroticism (the disposition to be sensitive/nervous, as opposed to being resilient/confident) predicts higher negative affect, while openness and extraversion (being more outgoing/energetic, as opposed to being solitary/reserved) predict higher positive affect.

It is, therefore, not surprising that individual differences in personality traits appear to play a role in the emotional response to the lockdown measures: higher neuroticism and lower extraversion have been associated with worse adaptation to lockdown (Carvalho et al., 2020; Morales-Vives et al., 2020) while Neuroticism has been found as a risk factor for psychological distress among Italian parents living with children (Mazza et al., 2020b).

As far as resilience and related coping strategies are concerned, studies show that they can be protective against the negative effects of stressors (Serafini et al., 2020). According to Fletcher and Sarkar (2013), resilience modulates how an event is evaluated, and based on this evaluation different coping strategies are engaged to manage the stress. With regard specifically to the role of resilience in the mental health outcome during the COVID-19 pandemic, Barzilay et al. (2020) provided evidence that a higher level of resilience was associated with lower COVID-19 related worries and a reduced level of anxiety and depression in both healthcare and non-healthcare professionals. Morales-Vives et al. (2020) supported this evidence, showing that people that best adapted to lockdown presented higher levels of resilience and successful coping.

Finally, evidence suggests that alexithymia, which describes a difficulty in identifying and describing subjective feelings and an externally oriented thinking (EOT) style (Sifneos, 1973), modulates the cortisol level in response to stress events (de Timary et al., 2008; Hua et al., 2014) and is a predictor for a high level of anxiety and depression (e.g., Honkalampi et al., 2000; Berardis et al., 2008; Fietz et al., 2018). Interestingly, it has been found that alexithymia has a mediator role in the association between COVID-19 pandemic exposure and PTSD and depressive symptoms (Tang et al., 2020).

Given the reviewed evidence, here we analyzed the data of an online survey evaluating the rate of stress, anxiety, and depression during the COVID-19 among the Italian population with two goals. *First*, the present study sought to investigate how personality traits, resilience, and alexithymia affected the level of anxiety, stress, and depression during COVID-19 home confinement. Using a bottom-up approach, we ran a cluster analysis on the individuals' self-reported level of stress, anxiety, and depression to divide participants into groups with a similar emotional response to the lockdown. We then compared these groups to identify psychological attributes more common among individuals with similar responses to the lockdown. *Second*, we investigated whether different psychological characteristics influence mental health differently depending on the scope of the confinement: while it has been shown that alexithymia, resilience, and personality traits have a role on the effects of lockdown on mental health (Barzilay et al., 2020; Carvalho et al., 2020; Mazza et al., 2020b; Morales-Vives et al., 2020; Tang et al., 2020), no study has so far considered all these factors together.

We, therefore, asked participants to rate their experiences during two different phases of the Italian lockdown. The first phase (Phase 1) of the lockdown in Italy, from the 10th of March to the 3rd of May was characterized by the strict enforcement of tight rules, such as the absolute prohibition to leave one's residence if not for health, work, or otherwise essential reasons. During the second phase of the lockdown (Phase 2),

which started on the 5th of May, some of these restrictions were lifted allowing people to leave their houses again to visit families and to do physical activity, and some non-essential activities. The data analyzed here were collected through an online survey administered during the second week of Phase 2: participants rated their experiences during the two phases, i.e., recollecting their experiences during the last 2 weeks of Phase 1, and reporting their evaluations of the first 2 weeks of Phase 2.

Our first hypothesis was that individuals who showed a better adaptation during the lockdown would show lower levels of neuroticism and alexithymia, and a higher level of resilience compared to individuals who suffered a stronger impact of the lockdown on their mental health. In addition, we hypothesized that individuals with personal characteristics linked to higher adaptability, such as high resilience, openness, and low neuroticism, would particularly benefit from the partial lift of restrictions that marked the beginning of Phase 2 of the lockdown.

MATERIALS AND METHODS

The data used in this study was acquired as part of a bigger project investigating the effects of the COVID-19 lockdown (Cecchetto et al., 2021).

Participants

The study protocol was approved by the Ethics Committee of the University of Padova and was conducted in accordance with the Declaration of Helsinki 2013. Data were collected anonymously through an online Survey on the Qualtrics XM Platform, shared *via* social media through a snowballing procedure in which participants were asked to invite friends to participate in the study. The required minimum sample size was set using Green's rule of thumb (Green, 1991), which yielded to a minimum number of participants of 154; however, our main constrain was temporal as data was only collected from the 14th to the 19th of May 2020. The target of the survey were Italian residents 18 or more years old. All respondents read the consent form and explicitly agreed to participate before starting the survey. No compensation for participating in the study was given.

Six hundred thirty-five participants started the survey. One hundred ninety-four participants were excluded for not completing the survey, seven because of missing information (five because of missing information on their gender), five because of pregnancy, two because they reported having contracted COVID-19, and 23 because they spent part or all of the lockdown outside the Italian territory. Moreover, 11 participants were excluded because they reported currently having a diagnosed psychiatric disorder. The final sample comprised 393 participants.

Measures

As described in Cecchetto et al. (2021), the online survey was composed of three parts. First, participants answered questions regarding socio-demographic information (age, gender, education, pregnancy, presence of pathologies, COVID-19 infection,

occupational status before the lockdown), and filled in the Toronto Alexithymia Scale (TAS-20; Bressi et al., 1996), the Brief Resilient Coping Scale (BRCS, Kocalevent et al., 2017) and the 10-item personality inventory (TIPI, Gosling et al., 2003; Chiorri et al., 2015). The TAS-20 measures the general level of alexithymia. Each item is scored from 1 (strongly disagree) to 5 (strongly agree), for a maximum total of 100 and it includes three subscales: Difficulty in identifying feelings (DIF; *difficulty identifying feelings and distinguishing between emotional feelings and the bodily sensations of emotional arousal*; Parker et al., 2003), difficulty in describing feelings (DCF; *difficulty finding words to describe feelings to other*; Parker et al., 2003) and EOT (*externally-oriented style of thinking*; Parker et al., 2003). The international cut-off values are the following: 20–50 = non-alexithymic subjects; 51–60 = borderline alexithymic subjects; 61–100 = alexithymic subjects (Bressi et al., 1996). The BRCS is a four-item scale measuring adaptive coping strategies. Responses are collected on a 5-points Likert scale ranging from 1 = “does not describe me at all” to 5 = “describes me very well.” The sum score varies between 4 and 20 where higher scores indicate higher levels of resilience. The TIPI is a short self-report measure of the big five personality traits (openness, conscientiousness, extraversion, agreeableness, and emotional stability) in which each personality dimension is measured by two items. All items are rated on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree).

In the second and third part of the survey, participants were asked to evaluate their level of well-being during the first and second phases of the lockdown, respectively. Participants filled in, for each phase, the Patient Health Questionnaire (PHQ-2; Kroenke et al., 2003), investigating depressive symptoms, the Generalized Anxiety Disorder scale (GAD-2; Kroenke et al., 2007), and the Perceived Stress Scale (PSS-10; Mondo et al., 2019). Participants were asked to fill the questionnaires referring to the last 2 weeks of the lockdown Phase 1, and the first 2 weeks of the lockdown Phase 2.

The PHQ-2 is a two-item screening tool that measures the frequency of depressed mood and anhedonia. Each item is scored from 0, “not at all,” to 3, “nearly every day.” A PHQ-2 ≥ 3 showed a sensitivity of 83% for major depression (Kroenke et al., 2003). The GAD-2 scale is composed of the first two items of the GAD-7 and it assesses core anxiety symptoms. Each item is scored from 0, “not at all,” to 3, “nearly every day.” Total scores range from 0 to 6 and 3 is considered the cut-off for clinically relevant anxiety symptoms (Kroenke et al., 2007). The PSS-10 is a 10-item scale measuring thoughts and feelings related to stressful events. It has six negatively- and four positively-stated items rated on a 5-point Likert scale ranging from 0, “never,” to 4, “very often.” Higher scores imply higher levels of perceived stress (Mondo et al., 2019) and the maximum possible score is 40.

Statistical Analyses

Data were cleaned and analyzed using the software R (R Core Team, 2017). All continuous variables were centered and scaled. The dependent variables consisted of the GAD, PHQ, and PSS questionnaires scores.

First, cluster analysis was performed based on the similarities and differences in reported levels of anxiety, depression, and stress in the two phases with the “kmeans” function from the R default stats package. The best number of clusters was determined with “NbCluster” (Charrad et al., 2014), which tests 30 methods that vary the combinations of the number of clusters and distance measures for the *k*-means clustering. Cluster stability was estimated through a bootstrapping approach (100 iterations) with the “bootcluster” package (Yu, 2017). Descriptive analyses on the resulted clusters were run using *t*-tests (stats package; R Core Team, 2017), chi-square tests (chisq.test function of the stats package, the R Core Team, 2017), and *post hoc* of variables with more than two levels (chisq.multcomp function, RVAideMemoire package; Hervé and Hervé, 2020).

Second, for each dependent variable (PHQ, GAD, and PSS), linear mixed models (LMMs) were computed using the “lmer” function (lme4 package, Bates et al., 2015) and explored using the Anova function type three of the car package (Fox et al., 2019). The predictors consisted of the five personality traits (openness, conscientiousness, extraversion, agreeableness, and emotional stability), the three subscales of alexithymia (DIF, DDF, EOT), the level of resilience, age, gender, and occupational status before the lockdown. All of these predictors were analyzed in interaction with the lockdown phase (first or second). In addition, a random intercept for participant ID was added to account for within-subject measures. To ensure that each predictor improved the models’ fit, models were simplified using the “step” function (lmerTest package, Kuznetsova et al., 2017), which relies on the AIC criterion (Bolker et al., 2009). Factors that did not significantly improve the models’ fit were removed (Depression: the level of resilience, DDF, EOT, agreeableness, conscientiousness, emotional stability, gender, occupational status before the lockdown; Anxiety: the level of resilience, DDF, EOT, agreeableness, conscientiousness, age, gender, occupational status before the lockdown; Stress: DDF, openness, conscientiousness, extraversion, agreeableness, and emotional stability, gender, occupational status before the lockdown). AIC values of the initial and final models were calculated using the anova function (stats package, R Core Team, 2017). Collinearity between predictors was measured by calculating the Variance Inflation Factors (VIF) with the vif function of the car package (Fox et al., 2019). *Post hoc* tests of interactions including categorical factors were corrected using the Benjamini & Hochberg’s False Discovery Rate method (Benjamini and Hochberg, 1995), and interactions including continuous factors were analyzed according to Aiken & West’s method (Aiken et al., 1991).

RESULTS

Sample Characteristics

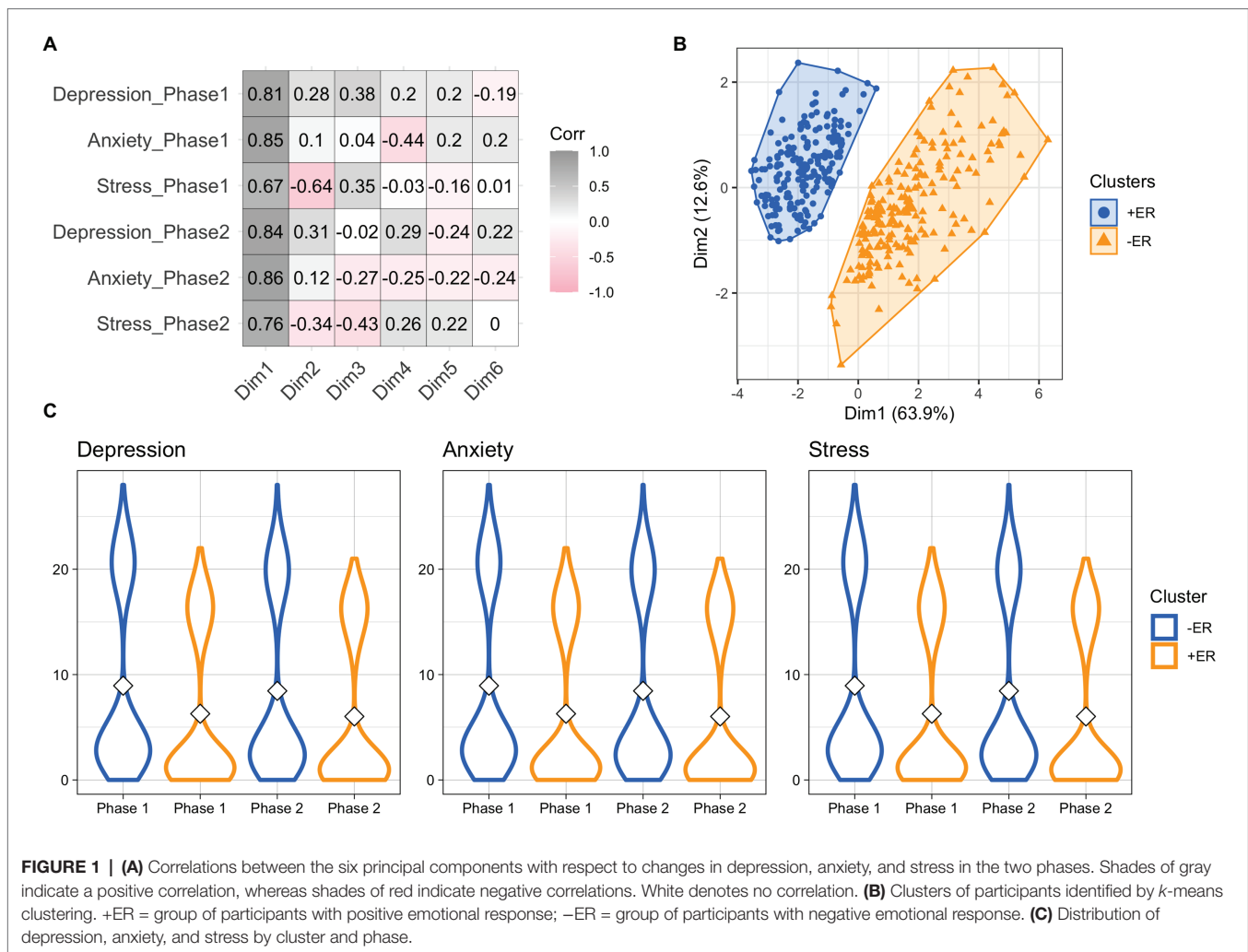
The final sample is composed of 293 women and 100 males aged between 18 and 74 (mean = 35.00, SD = 13.50). They reported to be students ($n = 115$), full-time workers ($n = 180$), part-time workers ($n = 57$), and non-employed (retired or

unemployed, $n = 41$) before the lockdown. Of these participants, 15.8% were alexithymic and 84.2% not alexithymic. The mean of the BRCS score was 13.1 (SD = 3.4). With regard to the PHQ and GAD questionnaire, during Phase 1, 31.6% were above the cut-off for depression and 28.0% were above the cut-off for anxiety, while during Phase 2, 21.1% were above the cut-off for depression and 20.6% were above the cut-off for anxiety. The mean score for PSS during Phase 1 was 18.7 (SD = 3.1) and during Phase 2 was 18.1 (SD = 3.0).

Characterization of the Sample by Levels of Anxiety, Depression, and Stress

To better characterize our sample, a *k*-means algorithm was used to cluster participants based on the similarities and differences in the reported levels of anxiety, depression, and stress in the two phases (Figures 1A,B; see Supplementary Figure 1A in the Supplemental Material for a 3D representation of the clusters). The analysis showed that participants were clustered into two groups (bootstrapped stability = 0.93). Cluster 1 ($N = 192$) is composed by individuals with overall lower scores of depression, anxiety, and stress in both phases (cluster 1 means, Phase1: PHQ = 1.33, PSS = 16.41, GAD = 1.10; Phase 2, PHQ = 1.11, PSS = 16.04, GAD = 0.93). Cluster 2 ($N = 201$) is characterized by higher scores of depression, anxiety, and stress in both phases (cluster 2 means, Phase 1: PHQ = 2.99, PSS = 20.86, GAD = 2.97; Phase 2, PHQ = 2.57, PSS = 20.06, GAD = 2.72; Figure 1C). Since the cluster mean of cluster 1 is below cut-offs, we defined this group as reporting a better emotional response to the lockdown (positive emotional response, +ER) while cluster 2, which presents cluster means above cut-offs, includes participants with a negative emotional response to the lockdown (−ER).

Further investigations showed that the two groups significantly differ in age [$t(381.75) = 3.06$, $p = 0.002$], as group +ER includes older participants (mean = 37.12, SD = 14.14) than group −ER (mean = 32.97, SD = 12.66) and in distribution of women and men [$\chi^2(1) = 11.00$, $p < 0.001$]: men were significantly more likely to be part of group +ER (67% of the total; $p < 0.001$) while the percentage of women did not significantly differ in the two groups (+ER, 42.7%, $p = 0.14$). The two groups also differ for the reported job before the lockdown [$\chi^2(3) = 90.90$, $p = 0.019$]: as students were significantly more likely to be clustered in group −ER (61.74%, $p = 0.019$) while none of the other groups presents significant difference in the distribution of the two groups). Importantly, the two groups were also significantly different for the participants’ level of alexithymia [$t(390.75) = -5.65$, $p < 0.001$; group +ER, mean = 43.01, SD = 10.98; group −ER, mean = 50.00, SD = 11.78]. Considering the subscales of alexithymia, they were significantly different in the DIF [$t(379.78) = -8.40$, $p < 0.001$; group +ER, mean = 13.88, SD = 5.24; group −ER, mean = 18.88, SD = 6.53] and in the DDF [$t(389.59) = -4.55$, $p < 0.001$; group +ER, mean = 11.98, SD = 4.50; group −ER, mean = 14.04, SD = 4.44], but not in the EOT [$t(390.22) = 1.35$, $p = 0.18$; group +ER, mean = 17.15, SD = 4.20; group −ER, mean = 16.58, SD = 4.21]. Moreover, the two groups differ for resilience [$t(389.54) = 2.40$, $p = 0.017$; group +ER,



mean = 13.47, SD = 3.36; group -ER, mean = 12.66, SD = 3.31]. There was no significant difference in any trait of personality except for emotional stability [$t(390.68) = 7.16, p < 0.001$; group +ER, mean = 4.59, SD = 1.28; group -ER, mean = 3.63, SD = 1.38].

The Effects of Alexithymia, Resilience, and Personality on Individual Well-Being in the Two Phases of the Lockdown

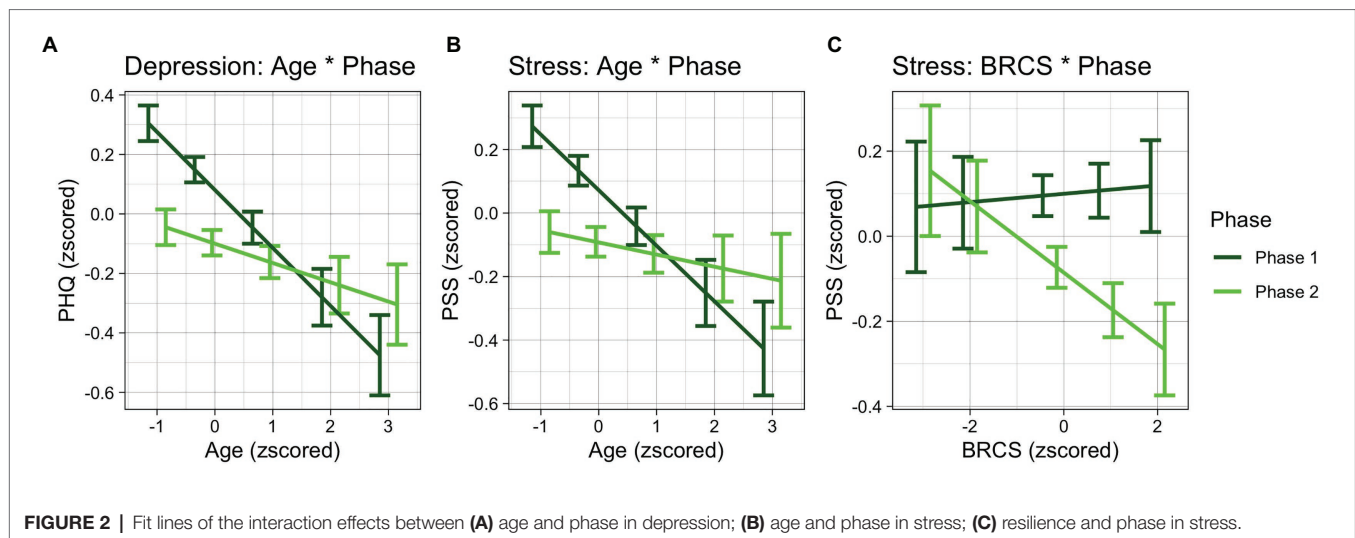
To evaluate the specific effects of personality, resilience, and alexithymia dependent on the phase of the lockdown on stress, anxiety, and depression, we computed a LMM for each emotional measure. The final model investigating PHQ included phase, the DIF subscale of alexithymia, emotional stability, openness to experience, extraversion, and age, and ID as a random factor (initial AIC = 1,787.3, final AIC = 1,758.4, $p = 0.86$).

$$\text{PHQ} \sim \text{Phase} + \text{DIF} + \text{Emotional Stability} + \text{Extraversion} + \text{Openness To Experiences} + \text{Age} + \text{Phase} * \text{Age} + (1|\text{ID}).$$

Conditional R^2 was equal to 0.74, and marginal R^2 was equal to 0.31. Results showed a main effect for each predictor [Phase: $\chi^2(1) = 37.16, p < 0.001$; TAS-DIF: $\chi^2(1) = 58.22,$

$p < 0.001$; Emotional stability: $\chi^2(1) = 18.73, p < 0.001$; Extraversion: $\chi^2(1) = 9.43, p = 0.002$; Openness to experiences: $\chi^2(1) = 6.71, p = 0.010$; Age: $\chi^2(1) = 20.75, p < 0.001$]. The main effect of phase showed an overall higher level of depression in Phase 1 than Phase 2. Results indicate that higher levels of depression were found among participants reporting higher scores in difficulties identifying feelings and who reported higher scores in openness to experience. On the other hand, lower levels of depression were found among participants who reported higher scores in emotional stability and extraversion. The interaction between age and phase [$\chi^2(1) = 13.02, p < 0.001$; see **Figure 2A**] showed that during Phase 1, age indirectly correlated with depression [$t(554.8) = -4.56, p < 0.001$], while age did not affect depression scores in Phase 2 [$t(554.78) = -1.52, p = 0.13$], and that among younger participants, but not among older ones, depression was higher in Phase 1 than in Phase 2 [younger: $t(393) = -6.86, p < 0.001$; older: $t(393) = -1.76, p = 0.080$].

The final model investigating GAD included phase, DIF, and EOT of TAS, Emotional stability, Extraversion and openness to experience of TIPI, and ID as a random factor (initial AIC = 1,731.6, final AIC = 1,703.6, $p = 0.76$).



$$\text{GAD} \sim \text{Phase} + \text{DIF} + \text{EOT} + \text{Emotional Stability} + \text{Extraversion} + \text{Openness To Experiences} + (1|\text{ID}).$$

Conditional R^2 was equal to 0.75, and marginal R^2 was equal to 0.37. Results showed a main effect for each predictor [Phase: $\chi^2(1) = 14.40$, $p < 0.001$; DIF: $\chi^2(1) = 78.88$, $p < 0.001$; EOT: $\chi^2(1) = 10.06$, $p = 0.002$; Emotional stability: $\chi^2(1) = 43.92$, $p < 0.001$; Extraversion: $\chi^2(1) = 4.91$, $p = 0.027$; Openness to experiences: $\chi^2(1) = 7.60$, $p = 0.006$] meaning that Phase 1 predicted a higher level of anxiety than Phase 2. Moreover, the two components of alexithymia showed an opposite effect: a higher level of difficulties to identify emotions predicted a higher level of anxiety but a higher level of external-oriented thinking predicted a lower level of anxiety. With respect to personality, higher levels of openness to experience predicted a higher level of anxiety while a higher level of emotional stability and extraversion predicted a lower level of anxiety.

The final model investigating PSS included phase, BRCS, DIF of TAS, EOS of TAS, age, and ID as random factors (initial AIC = 2,030.6, final AIC = 2,005.1, $p = 0.68$).

$$\text{PSS} \sim \text{Phase} + \text{BRCS} + \text{DIF} + \text{EOT} + \text{Age} + \text{Phase} : \text{Age} + \text{Phase} : \text{BRCS} + (1|\text{ID}).$$

Conditional R^2 was equal to 0.55, and marginal R^2 was equal to 0.55. Results revealed a main effect for phase [$\chi^2(1) = 17.03$, $p < 0.001$], DIF [$\chi^2(1) = 67.09$, $p < 0.001$], EOT [$\chi^2(1) = 10.59$, $p = 0.001$], age [$\chi^2(1) = 13.99$, $p < 0.001$] and a significant interaction between phase and BRCS [$\chi^2(1) = 3.87$, $p = 0.049$], and between phase and age [$\chi^2(1) = 8.23$, $p = 0.004$]. Results indicate that Phase 1 was a predictor of higher levels of stress as compared to Phase 2. As for anxiety, we found that a higher level of difficulties to identify emotions predicted a higher level of stress but a higher level of external-oriented thinking predicted a lower level of stress. As in depression, the interaction between age and phase specified that age predicted lower levels of stress in Phase 1 [$t(638.43) = -3.74$, $p < 0.001$; **Figure 2B**] but not in Phase 2 [$t(638.43) = -0.82$, $p = 0.41$], and that younger respondents

had higher levels of stress in Phase 1 than in Phase 2 [$t(393) = -4.95$, $p < 0.001$], while this difference did not occur among older respondents [$t(393) = -0.89$, $p = 0.38$]. *Post hoc* on the interaction between phase and BRCS showed that resilience does not have effect in Phase 1 [$t(616.89) = 0.20$, $p = 0.84$; **Figure 2C**] while in Phase 2 it shows a trend of significance [$t(616.89) = -1.72$, $p = 0.086$], moreover it showed that in participants with higher levels of resilience [$t(393) = -4.31$, $p < 0.001$] the difference between phases is stronger than in participants with lower levels of resilience [$t(393) = -1.52$, $p = 0.13$].

DISCUSSION

The aim of the present study was twofold. First, through a cluster analysis, we characterized our sample of participants based on their level of anxiety, stress, and depression to unravel the psychological characteristics (personality traits, alexithymia, and resilience) of those who reported a stronger impact of the lockdown on mental health. Second, we explored more deeply the role of personality traits, alexithymia, and resilience on anxiety, stress, and depression in relation to the scope of the confinement.

Characterization of the Sample Based on the Emotional Response to the Lockdown

Our results showed that individuals who had a better emotional response during the lockdown were characterized by high emotional stability, high resilience, and lower difficulties in identifying and describing feelings. In particular, the cluster analysis reported that our sample was best defined by two clusters, which included participants reporting a better emotional response to the lockdown (+ER, lower levels of depression, stress, and anxiety in both phases of the lockdown) and participants reporting negative effects on mental health (-ER, higher levels of depression, stress, and anxiety), respectively. Compared to the -ER group, +ER individuals showed higher

scores of emotional stability, in line with previous results showing that individuals with higher emotional stability (lower neuroticism) reacted better to the lockdown (Mazza et al., 2020b; Morales-Vives et al., 2020). Moreover, they had a higher resilience score, which is in line with what has been already reported by Morales-Vives et al. (2020) and Barzilay et al. (2020), confirming that resilience can protect a person from negative emotional distress due to the pandemic. Finally, individuals of the $-ER$ group, in contrast to $+ER$ individuals, presented significantly higher levels of alexithymia, in particular in the difficulties in identifying and describing feelings subscales (DIF and DDF subscales of TAS questionnaire), a result in line with Tang et al. (2020) who reported a significant correlation between depression and PTSD symptoms and DIF and DDF subscales of alexithymia. In addition, the $-ER$ cluster included younger individuals, a higher ratio of women, and students. This evidence confirms what was reported in the meta-analysis by Salari et al. (2020), i.e., that the prevalence of anxiety, depression, and stress during the COVID-19 pandemic is higher in women than in men and in individuals aged between 21 and 40. As suggested by Salari et al. (2020), women are in general more vulnerable to stress and post-traumatic stress disorder than men (Sareen et al., 2013; Lim et al., 2018). Moreover, younger people, even though they are less prone to undergo a severe illness caused by COVID-19, are probably more concerned over the future consequences of the pandemic than older people (Salari et al., 2020). This may contribute to the observed effect that students are more affected by the negative effects of lockdown than workers or unemployed individuals (the latter group included retired people, too); finally, students may have been more affected in terms of life changes, such as daily significant interactions, place of residence, and social life. Our results offer new evidence on the role of personality traits, resilience, and alexithymic tendencies in making individuals differently vulnerable to psychological distress during the lockdown.

The Effects of the Severity of Imposed Restrictions on Mental Health

As already reported in Cecchetto et al. (2021), all the measures of psychological distress decreased significantly in Phase 2 as compared to Phase 1, showing that the loosening of the restrictions during Phase 2 helped people to better deal with home confinement. These results extended the findings of Morales-Vives et al. (2020) according to which the level of stress increased between the first and the third week of lockdown in Spain when restrictions became more severe. It is important to notice that, differently from Morales-Vives et al. (2020) who collected data from separated samples of participants across weeks, we reported measures from the same group of participants in the two phases. Avoiding most of the risks associated with interindividual differences, our within-subject comparison allows establishing a solid methodological background for a better understanding of the effects of personal features on psychological distress during the lockdown. Importantly, we observed that the severity of imposed restrictions had a different effect on mental health depending on the participants' resilience and age. In particular, individuals with

higher resilience, as compared to those with low resilience, exhibit a higher reduction in the stress level in Phase 2. This result may suggest that stronger resilience abilities helped individuals to recover in Phase 2 from the stress accumulated during Phase 1. Moreover, the contrast between strict and soft lockdown was particularly relevant for young people, since they reported a reduction of depression and stress in Phase 2 as compared to Phase 1.

Effects of Psychological Traits on Depression, Anxiety, and Stress

The analysis of the effect of each psychological dimension separately on depression, anxiety, and stress levels, yielded interesting results. First, as to personality, we found that higher levels of emotional stability and extraversion, and lower levels of openness to experience predicted lower levels of depression and anxiety in both phases of the lockdown. At the same time, they did not affect stress levels. These results confirm previous studies showing that personality traits, and in particular extraversion and neuroticism, are strongly related to psychological well-being (see for example, Grant et al., 2009).

Second, resilience affected specifically the level of stress but not that of depression and anxiety. This suggests that coping strategies may be particularly useful in highly stressful situations and to cope with emergencies, as their effect on mental health consists of reducing the perceived stress, but not in protecting from long-term mood and anxiety disorders.

Third, regarding the role of alexithymia, we found that the DIF and EOT subscales impact emotional wellbeing. However, while higher levels of DIF predicts higher levels of depression, anxiety, and stress, higher levels of EOT seems to have a protective role for stress and anxiety. It has been reported that the sub-dimensions of alexithymia are probably related to different neural correlates, with the subscales measuring the difficulties identifying and describing feelings more related to each other and emotional distress (Parker et al., 2003; Eichmann et al., 2008; Pollatos et al., 2011). DIF has been frequently associated with increased negative affect and psychological distress (Liss et al., 2008; Li et al., 2015; Bagby et al., 2020). It is possible that the incapability of identifying feelings from bodily sensation may lead to difficulties in the evaluation and the regulation of emotions, making these individuals more vulnerable to chronic stress and mental illness (Preece et al., 2017; Fournier et al., 2020). On the other side, EOT has been associated with a reduced interest in viewing negative pictures (Wiebe et al., 2017) and with a utilitarian way of perception and avoid dealing with negative emotions (Taylor and Bagby, 2000), features that could have become useful in the current pandemic situation. In this framework, our findings suggest that while resilience can help cope with stress, alexithymia, and personality play a major role in influencing anxiety and depression.

General Considerations

Two general considerations emerge from the present study. First, anxiety, depression, and stress were predicted by similar,

though different, patterns of psychological dimensions. While personality traits influenced individual anxiety and depression, they did not affect the level of stress. On the other hand, resilience only affected stress but did not influence anxiety and depression. These results suggest that while personality impacts longer-term measures of emotional reaction, resilience may help only in modulating the perceived level of stress during such an exceptionally arousing event. This may offer a useful indication to mental health professionals as to the importance of different treatment goals depending on the context: during an emergency, it may be particularly useful in alleviating stress to enhance individuals' coping strategies, while during long-term interventions focusing on anxiety and depressive symptoms a deeper work on personality constructs may be better indicated.

Second, unintuitively, alexithymic traits, and not the lack of resilience, may make individuals more vulnerable in extremely stressful circumstances. Indeed, resilience has only a marginal role in protecting individuals from the negative effects of lockdown and only in interaction with the loosening of restrictions. Resilience is considered a skill that is used to deal with and overcome stressful events and that helps not to develop maladaptive behaviors (Craparo et al., 2018) while, on the other hand, alexithymia is considered a stable personality trait (Luminet et al., 2001; Tolmunen et al., 2011). Probably for this reason, previous studies investigating the effects of the lockdown on psychological well-being seem to have focused more on resilience than alexithymia (Barzilay et al., 2020; Fullana et al., 2020; Landi et al., 2020, but see Tang et al., 2020). However, alexithymia can constitute a negative predictor for psychological treatment outcomes (Pinna et al., 2020) and recent treatment focus has been shifting on possible interventions on individuals with alexithymia, improving patients' attentional control over interoceptive signals (Duquette, 2020). Our results suggest that interventions aiming at supporting the population during future lockdowns should therefore pay particular attention to individuals with alexithymic traits, as they may be less likely to seek support while being in need of it.

Limitations

The present study presents some limitations. First, the study is not a longitudinal one and, although the same respondents provided the data regarding Phase 1 and Phase 2, the data has been collected relying on the abilities of the participants to remember how they had felt a week earlier. Future studies should implement a longitudinal design to confirm the effect of the scope of confinement on the variation of psychological well-being. Second, to comply with the exceptionality of the pandemic and the lockdown restrictions, the data were collected through self-report questionnaires presented online. This could have had an impact on the reported levels of anxiety, depression, and stress, which may not always converge with what would have resulted from an in-person assessment. In addition, we chose to administer brief versions of the questionnaires measuring depression and anxiety, to diminish the total number of survey questions that would have discourage

individuals from participating. However, the selected tools were validated and have been commonly used. Third, the sample size is composed of an unequal number of women and men, as it has been recruited using non-probability sampling, which limits the generalizability of the findings. This is an issue familiar to many studies based on an online survey (Salari et al., 2020) that has been previously reported (Smith, 2008; Saleh and Bista, 2017). In the present study, we have tried to account for this issue by including gender as a fixed factor in the initial models. Fourth, our sample is rather small for an online survey; however, for the sake of the particular experimental design and the extraordinary historical moment, our survey was kept available only for 6 days to be still able to collect reliable answers related to Phase 1 but at the same time to have people already felt the effects of Phase 2.

Despite these limitations, the current study provides valuable information on the factors influencing mental health during the COVID-19 lockdown, specifically in association with the influence of the scope of the confinement. We find that alexithymia and personality traits, together with age and gender, significantly impact the individuals' levels of stress, anxiety, and depression, and that resilience is a protective factor specifically against stress, especially when lockdown restrictions are less strict. These indications expand the current knowledge of the influence of individual differences on emotional well-being during such an exceptionally stressful situation and can offer an indication of the kind of interventions that governments could put in place to limit the negative effects of confinement during future lockdowns.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: the preprocessed datasets and the R code for the reported analyses can be found on the Open Science Framework database (https://osf.io/ukx5e/?view_only=746d4bfba444465e8d341bb63cf2eda9).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the University of Padova. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MA, CC, and SO: development of the study concept and the study design, and data collection. SO and CC: data analysis under the supervision of MA, data interpretation, and manuscript writing. MA, CG, and SI: review and editing.

MA and CG: supervision and project administration. All authors contributed to the article and approved the submitted version.

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REFERENCES

- Aiken, L. S., West, S. G., and Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, California, USA: Sage.
- Bagby, R. M., Parker, J. D. A., and Taylor, G. J. (2020). Twenty-five years with the 20-item Toronto alexithymia scale. *J. Psychosom. Res.* 131:109940. doi: 10.1016/j.jpsychores.2020.109940
- Barzilay, R., Moore, T. M., Greenberg, D. M., DiDomenico, G. E., Brown, L. A., White, L. K., et al. (2020). Resilience, COVID-19-related stress, anxiety and depression during the pandemic in a large population enriched for healthcare providers. *Transl. Psychiatry* 10:291. doi: 10.1038/s41398-020-00982-4
- Bates, D., Mächler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using {lme4}. *J. Stat. Softw.* 67, 1–48. doi: 10.18637/jss.v067.i01
- Benjamini, Y., and Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J. R. Stat. Soc. Series B* 57, 289–300.
- Berardis, D. D., Campanella, D., Nicola, S., Gianna, S., Alessandro, C., Chiara, C., et al. (2008). The impact of alexithymia on anxiety disorders: a review of the literature. *Curr. Psychiatr. Rev.* 4, 80–86. doi: 10.2174/157340008784529287
- Bolker, B. M., Brooks, M. E., Clark, C. J., Geange, S. W., Poulsen, J. R., Stevens, M. H. H., et al. (2009). Generalized linear mixed models: a practical guide for ecology and evolution. *Trends Ecol. Evol.* 24, 127–135. doi: 10.1016/j.tree.2008.10.008
- Bressi, C., Taylor, G., Parker, J., Bressi, S., Brambilla, V., Aguglia, E., et al. (1996). Cross validation of the factor structure of the 20-item Toronto alexithymia scale: an Italian multicenter study. *J. Psychosom. Res.* 41, 551–559. doi: 10.1016/S0022-3999(96)00228-0
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8
- Carvalho, L. d. F., Pianowski, G., and Gonçalves, A. P. (2020). Personality differences and COVID-19: are extroversion and conscientiousness personality traits associated with engagement with containment measures? *Trends Psychiatry Psychother.* 42, 179–184. doi: 10.1590/2237-6089-2020-0029
- Castelli, L., Di Tella, M., Benfante, A., and Romeo, A. (2020). The spread of COVID-19 in the Italian population: anxiety, depression, and post-traumatic stress symptoms. *Can. J. Psychiatr.* 65, 731–732. doi: 10.1177/0706743720938598
- Cecchetto, C., Aiello, M., Ionta, S., Gentili, C., and Osimo, S. A. (2021). Increased emotional eating during COVID-19 associated with lockdown, psychological and social distress. *Appetite* 160:105122. doi: 10.1016/j.appet.2021.105122
- Charrad, M., Ghazzali, N., Boiteau, V., and Niknafs, A. (2014). NbClust: an R Package for determining the relevant number of clusters in a data set. *J. Stat. Softw.* 61, 1–36. doi: 10.18637/jss.v061.i06
- Chiorri, C., Bracco, F., Piccinno, T., Modafferi, C., and Battini, V. (2015). Psychometric properties of a revised version of the ten item personality inventory. *Eur. J. Psychol. Assess.* 31, 109–119. doi: 10.1027/1015-5759/a000215
- Craparo, G., Magnano, P., Zapparrata, M. V., Gori, A., Costanzo, G., Pace, U., et al. (2018). Coping, attachment style and resilience: the mediating role of alexithymia. *Mediterr. J. Clin. Psychol.* 6, 1–30. doi: 10.6092/2282-1619/2018.6.1773
- de Timary, P., Roy, E., Luminet, O., Fillée, C., and Mikolajczak, M. (2008). Relationship between alexithymia, alexithymia factors and salivary cortisol in men exposed to a social stress test. *Psychoneuroendocrinology* 33, 1160–1164. doi: 10.1016/j.psyneuen.2008.06.005
- Di Giuseppe, M., Zilcha-Mano, S., Prout, T. A., Perry, J. C., Orrù, G., and Conversano, C. (2020). Psychological impact of coronavirus disease 2019 among Italians during the first week of lockdown. *Front. Psych.* 11:576597. doi: 10.3389/fpsy.2020.576597
- Duquette, P. (2020). More than words can say: a multi-disciplinary consideration of the psychotherapeutic evaluation and treatment of alexithymia. *Front. Psych.* 11:433. doi: 10.3389/fpsy.2020.00433
- Eichmann, M., Kugel, H., and Suslow, T. (2008). Difficulty identifying feelings and automatic activation in the fusiform gyrus in response to facial emotion. *Percept. Mot. Skills* 107, 915–922. doi: 10.2466/pms.107.3.915-922
- Fietz, J., Valencia, N., and Silani, G. (2018). Alexithymia and autistic traits as possible predictors for traits related to depression, anxiety, and stress: a multivariate statistical approach. *J. Eval. Clin. Pract.* 24, 901–908. doi: 10.1111/jep.12961
- Fletcher, D., and Sarkar, M. (2013). Psychological resilience: a review and critique of definitions, concepts, and theory. *Eur. Psychol.* 18:12. doi: 10.1027/1016-9040/a000124
- Fournier, A., Mondillon, L., Luminet, O., Canini, F., Mathieu, N., Gauchez, A. S., et al. (2020). Interoceptive abilities in inflammatory bowel diseases and irritable bowel syndrome. *Front. Psych.* 11:229. doi: 10.3389/fpsy.2020.00229
- Fox, J., Weisberg, S., and Price, B. (2019). *carData: Companion to Applied Regression Data Sets*. Available at: <https://cran.r-project.org/package=carData> (Accessed February 08, 2021).
- Franceschini, C., Musetti, A., Zenesini, C., Palagini, L., Scarpelli, S., Quattropani, M. C., et al. (2020). Poor sleep quality and its consequences on mental health during the COVID-19 lockdown in Italy. *Front. Psychol.* 11:3072. doi: 10.3389/fpsy.2020.574475
- Fullana, M. A., Hidalgo-Mazzei, D., Vieta, E., and Radua, J. (2020). Coping behaviors associated with decreased anxiety and depressive symptoms during the COVID-19 pandemic and lockdown. *J. Affect. Disord.* 275, 80–81. doi: 10.1016/j.jad.2020.06.027
- Goldberg, L. R. (1990). An alternative "description of personality": the big-five factor structure. *J. Pers. Soc. Psychol.* 59, 1216–1219. doi: 10.1037//0022-3514.59.6.1216
- Gosling, S. D., Rentfrow, P. J., and Swann, W. B. Jr. (2003). A very brief measure of the big-five personality domains. *J. Res. Pers.* 37, 504–528. doi: 10.1016/S0092-6566(03)00046-1
- Grant, S., Langan-Fox, J., and Anglim, J. (2009). The big five traits as predictors of subjective and psychological well-being. *Psychol. Rep.* 105, 205–231. doi: 10.2466/PRO.105.1.205-231
- Green, S. B. (1991). How many subjects does it take to do a regression analysis. *Multivar. Behav. Res.* 26, 499–510. doi: 10.1207/s15327906mbr2603_7
- Hervé, M., and Hervé, M. M. (2020). Package 'RVAideMemoire'. Available at: <https://CRAN.R-Project.Org/Package=RVAideMemoire> (Accessed September 30, 2020).
- Honkalampi, K., Hintikka, J., Tanskanen, A., Lehtonen, J., and Viinamäki, H. (2000). Depression is strongly associated with alexithymia in the general population. *J. Psychosom. Res.* 48, 99–104. doi: 10.1016/S0022-3999(99)00083-5
- Hua, J., Le Scannf, C., Larue, J., José, F., Martin, J. -C., Devillers, L., et al. (2014). Global stress response during a social stress test: impact of alexithymia and its subfactors. *Psychoneuroendocrinology* 50, 53–61. doi: 10.1016/j.psyneuen.2014.08.003

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.630751/full#supplementary-material>

- Kocalevent, R. -D., Zenger, M., Hinz, A., Klapp, B., and Brähler, E. (2017). Resilient coping in the general population: standardization of the brief resilient coping scale (BRCS). *Health Qual. Life Outcomes* 15:251. doi: 10.1186/s12955-017-0822-6
- Kroenke, K., Spitzer, R. L., and Williams, J. B. W. (2003). The patient health Questionnaire-2: validity of a two-item depression screener. *Med. Care* 41, 1284–1292. doi: 10.1097/01.MLR.0000093487.78664.3C
- Kroenke, K., Spitzer, R. L., Williams, J. B. W., Monahan, P. O., and Löwe, B. (2007). Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann. Intern. Med.* 146, 317–325. doi: 10.7326/0003-4819-146-5-200703060-00004
- Kuznetsova, A., Brockhoff, P. B., and Christensen, R. H. B. (2017). lmerTest package: tests in linear mixed effects models. *J. Stat. Softw.* 82, 1–26. doi: 10.18637/jss.v082.i13
- Landi, G., Pakenham, K. I., Boccolini, G., Grandi, S., and Tossani, E. (2020). Health anxiety and mental health outcome during COVID-19 lockdown in Italy: the mediating and moderating roles of psychological flexibility. *Front. Psychol.* 11:2195. doi: 10.3389/fpsyg.2020.02195
- Li, S., Zhang, B., Guo, Y., and Zhang, J. (2015). The association between alexithymia as assessed by the 20-item Toronto alexithymia scale and depression: a meta-analysis. *Psychiatry Res.* 227, 1–9. doi: 10.1016/j.psychres.2015.02.006
- Lim, G. Y., Tam, W. W., Lu, Y., Ho, C. S., Zhang, M. W., and Ho, R. C. (2018). Prevalence of depression in the community from 30 countries between 1994 and 2014. *Sci. Rep.* 8:2861. doi: 10.1038/s41598-018-21243-x
- Liss, M., Mailloux, J., and Erchull, M. J. (2008). The relationships between sensory processing sensitivity, alexithymia, autism, depression, and anxiety. *Personal. Individ. Differ.* 45, 255–259. doi: 10.1016/j.paid.2008.04.009
- Luminet, O., Bagby, R. M., and Taylor, G. J. (2001). An evaluation of the absolute and relative stability of alexithymia in patients with major depression. *Psychother. Psychosom.* 70, 254–260. doi: 10.1159/000056263
- Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., et al. (2020a). A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int. J. Environ. Res. Public Health* 17:3165. doi: 10.3390/ijerph17093165
- Mazza, C., Ricci, E., Marchetti, D., Fontanesi, L., Di Giandomenico, S., Verrocchio, M. C., et al. (2020b). How personality relates to distress in parents during the Covid-19 lockdown: the mediating role of child's emotional and behavioral difficulties and the moderating effect of living with other people. *Int. J. Environ. Res. Public Health* 17:6236. doi: 10.3390/ijerph17176236
- Mondo, M., Sechi, C., and Cabras, C. (2019). Psychometric evaluation of three versions of the Italian perceived stress scale. *Curr. Psychol.* 1–9. doi: 10.1007/s12144-019-0132-8
- Morales-Vives, F., Dueñas, J. -M., Vigil-Colet, A., and Camarero-Figuerola, M. (2020). Psychological variables related to adaptation to the COVID-19 lockdown in Spain. *Front. Psychol.* 11:2438. doi: 10.3389/fpsyg.2020.565634
- Oswald, L. M., Zandi, P., Nestadt, G., Potash, J. B., Kalaydjian, A. E., and Wand, G. S. (2006). Relationship between cortisol responses to stress and personality. *Neuropsychopharmacology* 31, 1583–1591. doi: 10.1038/sj.npp.1301012
- Parker, J. D. A., Taylor, G. J., and Bagby, R. M. (2003). The 20-item Toronto alexithymia scale: III. Reliability and factorial validity in a community population. *J. Psychosom. Res.* 55, 269–275. doi: 10.1016/s0022-3999(02)00578-0
- Pinna, F., Manchia, M., Paribello, P., and Carpiniello, B. (2020). The impact of alexithymia on treatment response in psychiatric disorders: a systematic review. *Front. Psych.* 11:311. doi: 10.3389/fpsyg.2020.00311
- Pollatos, O., Werner, N. S., Duschek, S., Schandry, R., Matthias, E., Traut-Mattausch, E., et al. (2011). Differential effects of alexithymia subscales on autonomic reactivity and anxiety during social stress. *J. Psychosom. Res.* 70, 525–533. doi: 10.1016/j.jpsychores.2010.12.003
- Preece, D., Becerra, R., Allan, A., Robinson, K., and Dandy, J. (2017). Establishing the theoretical components of alexithymia via factor analysis: introduction and validation of the attention-appraisal model of alexithymia. *Personal. Individ. Differ.* 119, 341–352. doi: 10.1016/j.paid.2017.08.003
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., and Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen. Psychiatry* 33:e100213. doi: 10.1136/gpsych-2020-100213
- R Core Team (2017). *R: A language and environment for statistical computing* (3.4.3). 3.4.3. Available at: <http://www.r-project.org/> (Accessed February 08, 2021).
- Rossi, R., Soccì, V., Talevi, D., Mensi, S., Niolu, C., Pacitti, F., et al. (2020). COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. *Front. Psych.* 11:790. doi: 10.3389/fpsyg.2020.00790
- Salari, N., Hosseini-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., et al. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Glob. Health* 16:57. doi: 10.1186/s12992-020-00589-w
- Saleh, A., and Bista, K. (2017). Examining factors impacting online survey response rates in educational research: perceptions of graduate students. *J. Multidiscip. Res.* 13, 63–74.
- Sareen, J., Erickson, J., Medved, M. I., Asmundson, G. J. G., Enns, M. W., Stein, M., et al. (2013). Risk factors for post-injury mental health problems. *Depress. Anxiety* 30, 321–327. doi: 10.1002/da.22077
- Schneider, T. R., Rench, T. A., Lyons, J. B., and Riffle, R. R. (2012). The influence of neuroticism, extraversion and openness on stress responses. *Stress. Health* 28, 102–110. doi: 10.1002/smi.1409
- Segerstrom, S. C., and Smith, G. T. (2019). Personality and coping: individual differences in responses to emotion. *Annu. Rev. Psychol.* 70, 651–671. doi: 10.1146/annurev-psych-010418-102917
- Serafini, G., Parmigiani, B., Amerio, A., Aguglia, A., Sher, L., and Amore, M. (2020). The psychological impact of COVID-19 on the mental health in the general population. *QJM-Int. J. Med.* 113, 531–537. doi: 10.1093/qjmed/hcaa201
- Sifneos, P. E. (1973). The prevalence of 'Alexithymic' characteristics in psychosomatic patients. *Psychother. Psychosom.* 22, 255–262. doi: 10.1159/000286529
- Smith, G. (2008). Does gender influence online survey participation?: A record-linkage analysis of university faculty online survey response behavior. *ERIC Document Reproduction Service No. ED 501717*.
- Tang, W., Hu, T., Yang, L., and Xu, J. (2020). The role of alexithymia in the mental health problems of home-quarantined university students during the COVID-19 pandemic in China. *Personal. Individ. Differ.* 165:110131. doi: 10.1016/j.paid.2020.110131
- Taylor, G. J., and Bagby, R. M. (2000). "An overview of the alexithymia construct" in *The handbook of emotional intelligence: Theory, development, assessment, and application at home, school, and in the workplace*. eds. R. Bar-On and J. D. A. Parker (San Francisco, California, USA: Jossey-Bass), 40–67.
- Tolmunen, T., Heliste, M., Lehto, S. M., Hintikka, J., Honkalampi, K., and Kauhanen, J. (2011). Stability of alexithymia in the general population: an 11-year follow-up. *Compr. Psychiatry* 52, 536–541. doi: 10.1016/j.comppsy.2010.09.007
- Wiebe, A., Kersting, A., and Suslow, T. (2017). Deployment of attention to emotional pictures varies as a function of externally-oriented thinking: an eye tracking investigation. *J. Behav. Ther. Exp. Psychiatry* 55, 1–5. doi: 10.1016/j.jbtep.2016.11.001
- Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M. W., Gill, H., Phan, L., et al. (2020). Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J. Affect. Disord.* 277, 55–64. doi: 10.1016/j.jad.2020.08.001
- Yu, H. (2017). *bootcluster: Bootstrapping Estimates of Clustering Stability*. Available at: <https://cran.r-project.org/package=bootcluster> (Accessed September 30, 2020).

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Individual Differences Facing the COVID-19 Pandemic: The Role of Age, Gender, Personality, and Positive Psychology

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Research on individual differences in facing the COVID-19 pandemic seems to be crucial in order to design diverse and highly effective intervention strategies. This study uses a sample of 302 North American participants who were recruited through the crowdsourcing platform ProA; different profiles were established, profiling variables of interest in facing the COVID-19 outbreak. Socio-demographic and psychological (personality traits, gratitude, life purpose, and religiosity) variables were explored. These results are of interest if we want to deepen the study of individual differences at both a theoretical and applied level.

Keywords: crowdsourcing, SARS-CoV-2, positive psychology, personality, profiles, gratitude, religiosity, purpose of life

INTRODUCTION

The COVID-19 pandemic was the biggest social and health crisis to occur in 2020. The scientific community is working to cure the disease, to mitigate the side effects, and to provide preventive measures, such as isolation, to reduce infection rates. Many researchers have identified the effects of the pandemic on mental health and welfare issues among the general population (Ammar et al., 2020; Zheng et al., 2020). In fact, a large study involving 35 research organizations from Europe, North-Africa, Western Asia, and the Americas, with 1,047 participants, revealed the presence of psychosocial strain and lower life satisfaction during the enforced COVID-19 lockdowns, due to the large decreases in entertainment and in the amount of social activity with family and friends/neighbors (Ammar et al., 2020). Furthermore, a national public survey in Ireland showed that COVID-19-related quarantine was associated with significant increases in clinically significant symptoms of depression, stress, and anxiety (Burke et al., 2020).

Nevertheless, a large cross-sectional survey of more than 50,000 people in 26 countries found that not everyone was equally affected by the COVID-19 pandemic (Kowal et al., 2020). The results of this study were that younger people, women, those with lower levels of formal education, those who were single, those living with more children, or living in a country more severely affected by COVID-19, exhibited higher levels of stress. Therefore, research on individual differences due to the impact of the COVID-19 pandemic is necessary in the field of psychology.

In this sense, a point of interest for the scientific community is being able to identify different profiles and how people with these profiles deal with consequences of the COVID-19 lockdown based on various personality traits and strengths relating to positive psychology. Other authors have gone further with this, investigating the factors, traits, and strengths related to well-being in the time of a pandemic. For example, the effects of lockdown and the pandemic on the general population have been explored based on age and gender. Regarding age, the general consensus is that older people exhibit a feeling of greater well-being and less negative affectivity. In this way, a study found older people rated their quality of life, life satisfaction, and well-being during the pandemic higher than young people, and experienced lower levels of anxiety traits and coronavirus fears than the younger age groups. They experienced greater risk tolerance, sleep quality, and optimism, and had less difficulty relaxing than middle-aged respondents (Bidzan-Bluma et al., 2020). Another research study has shown that age was significantly and negatively associated with initial negative affect, but age did not influence the shape or rate of change over time. Moreover, although older adults showed higher positive affect and lower negative affect relative to younger adults, age differences in the trajectory of change did not emerge (Ebert et al., 2020). In relation to age, another study carried out with a sample majority of students, between 18 and 40 years old, showed mild to severe General Anxiety Disorder, and a high level of perceived stress, however, it is not known what the reasons might be for this age-determined difference (Rogowska et al., 2020). As for gender, some research suggests that female participants may experience less satisfaction with life and higher stress and anxiety throughout the coronavirus pandemic (Wang et al., 2020). Another study indicates that the variance of anxiety during the COVID-19 outbreak may be explained up to about 60% by variables like high stress, low general self-rated health, female gender, and frequent use of both emotion-oriented and task-oriented coping styles (Rogowska et al., 2020). However, other studies conducted in China during the COVID-19 pandemic outbreak did not find gender differences in mental health. Gender had no significant effect on anxiety among medical college students (Cao et al., 2020), as well as among the general population (Huang and Zhao, 2020). Furthermore, Zhang and Ma (2020) did not find gender differences regarding the stressful impact of the COVID-19 outbreak. These research inconsistencies may be related to cross-cultural differences, so further exploration is needed in different cultural contexts.

Previous research suggests that psychological consequences of the pandemic depend on personality, because this predicts behavioral responses and emotional regulation strategies to cope with the COVID-19 crisis, and these can influence physical and psychological health (Aschwanden et al., 2020; Gubler et al., 2020). In fact, a study on individual differences in the psychological consequences of COVID-19 found that facets of Extraversion, Neuroticism, and Openness were among the strongest and most important predictors of psychological outcomes, even after controlling for basic sociodemographic variables such as gender and age (Modersitzki et al., 2020). Similarly, a study carried out during the pandemic determined

that neuroticism and emotion regulation strategies were associated with greater feelings of loneliness and lower well-being (Gubler et al., 2020). Moreover, it was found that higher levels of neuroticism were associated with a slower increase in physical activity, whereas higher conscientiousness and agreeableness were related to a steeper increase in physical activity over time. As well as this, higher neuroticism and lower extraversion, agreeableness, and conscientiousness were related to higher average sedentary behavior (Aschwanden et al., 2020). In this way, it is key to highlight the importance of considering individual differences in relation to this topic.

Additionally, the study of Positive Psychology has been of great importance because positive resources can help maintain and improve mental health during the COVID-19 pandemic. This field of research has begun to show that a large percentage of the general population is capable of maintaining healthy levels of subjective and psychological well-being despite adverse circumstances, identifying the human strengths that make it possible to deal positively with adversity. For example, previous research indicates that resilient people report that one of the emotions that most effectively buffer the negative effects of adversity is gratitude (Fredrickson et al., 2003). Another testimony is that of the Dalai Lama, who was grateful to the Japanese for the harm they had inflicted on him, as it helped him develop as a person and grow spiritually (Fitzgerald, 1998). Survivors of Hurricane Andrew (1992) also reported that one of the central themes in their experience was an overwhelming sense of gratitude for what they had not lost during the hurricane (Coffman, 1996). In the wake of the tragedy of the 9/11 terrorist attacks, Peterson and Seligman (2003) assessed people before and after the event, showing that gratitude increased during this period. In addition, psychological interventions to increase gratitude had beneficial effects for Vietnam War veterans with Post-Traumatic Stress Disorder (Kashdan et al., 2006). These results suggest that gratitude may play an important role in what has recently been termed “post-traumatic growth,” referring to the benefits that can be experienced from overcoming trauma, despite the intense suffering from which it has originated (Bono et al., 2004). Specifically, several studies suggest that gratitude has an important role in promoting people’s subjective well-being and helps them cope better with adversity during the COVID-19 pandemic (Bono et al., 2020a). Additionally, meaning in life has been one of the strengths associated with resilience in the face of adversity. For example, a study indicated that meaningful living had a positive predictive effect on resilience and positive affect, as well as a negative predictive value on psychological health challenges and negative affect on the psychological health of young adults in the context of the pandemic (Arslan et al., 2020). Martínez-Martí et al. (2020) evaluated the trait strengths of the general Spanish population at two points throughout the pandemic, noting that all character strength factors at point #1 correlated positively with life satisfaction and positive affect, and negatively with negative affect and poor mental health at point #2. In the health context of the pandemic, a nurse’s sample (Sun et al., 2020) found self-coping styles included altruistic acts, team support, rational cognition, increased affection and gratefulness, development of professional responsibility, and self-reflection. In

addition to this, Nowicki et al. (2020), also in a nurse's sample, noted an increase in life meaning, so their current sense of meaning in life remains higher than the tendency to search for a sense of security, being able to adapt to painful experiences and generate post-traumatic growth effect. On the other hand, one of the variables that has been researched by Positive Psychology and has been revealed as a buffer against crises is religiosity. For example, research has shown that throughout the pandemic, Google searches for "prayer" (relative to all Google searches), were at the highest level ever recorded, and more than half of the world's population had prayed to end coronavirus (Bentzen, 2020). Another study carried out during the pandemic found that religiosity had a positive influence on health outcomes and could minimize the effects of social isolation (Lucchetti et al., 2020). However, other studies have shown that highly religious participants reported more unreasonable behavior (e.g., avoiding 5G networks, hoarding toilet paper) than participants with low religiosity, although these behaviors were mediated through emotionality (Kranz et al., 2020). For this reason, from the Positive Psychology approach, we are specifically interested in the personal strengths of gratitude, meaning in life, and religiosity as important variables to explore in relation to coping with COVID-19.

Thus, according to the scientific knowledge that has been uncovered, and its gaps, this study seeks to provide more evidence in the field of individual differences surrounding the situation of the COVID-19 pandemic. The aim of this study is to explore the factors of age, gender, personality, and variables of Positive Psychology (gratitude, meaning or purpose in life, and religiosity) in relation to affectation in the face of the COVID-19 pandemic.

MATERIALS AND METHODS

Design and Sample

A cross-sectional design was used. The study consisted of 302 US residents whose primary language was English. They were recruited from the Prolific ProA Platform (www.prolific.co), of which 153 (51%) were women and 149 (49%) were men. Ages ranged between 19 and 82 years old ($M = 45.07$, $SD = 15.94$).

Table 1 shows sociodemographic data such as generational breakdown and ethnicity and **Table 2** shows employment status, educational level, and marital status.

TABLE 1 | Sociodemographic characteristics: generational breakdown and ethnicity.

Generational breakdown	Percent	Ethnicity	Percent
18–29 years old	22	Asian	8
30–39 years old	17	Black	15
40–49 years old	15	Mixed race	5
50–59 years old	21	White	69
60 and more years old	25	Other	3

Instruments

A socio-demographic survey was created for this study (employment status, educational level, marital status, age, and gender).

The English adaptation of the Gratitude Questionnaire (G20, Bernabé-Valero et al., 2014) was used in the present study (Bernabé-Valero et al., 2020). This scale has four subscales and 20 items that were rated on a 7-pt scale ("1 = Strongly Disagree" to "7 = Strongly Agree"). The scores are obtained by adding the direct scores; the range of the total scale is from 20 to 140. The first subscale is Interpersonal Gratitude (IG)—gratitude that is experienced toward other people when receiving a gift or an act of kindness. It refers to benefactors with different types of relationships to the beneficiary and focuses on the evaluative, emotional, and behavioral elements of gratitude. This subscale has seven items (e.g., "I feel great joy when someone does me an important favor") and showed good reliability ($\alpha = 0.88$). The range of scores on this subscale is 7–49. The second subscale is Gratitude in the face of Suffering (GS)—this factor refers to the integration of suffering in the concept of gratitude. It assesses the ability to understand situations of suffering as beneficial and to feel gratitude nonetheless. Likewise, it assesses if the person is able to move forward despite difficulties and to use gratitude as a resource for resiliency. It includes the cognitive-evaluative and emotional elements of gratitude. This subscale has five items (e.g., "Even after times in my life when I only experienced suffering, I can feel gratitude for having had the strength to get through them") and showed excellent reliability ($\alpha = 0.92$). The range of scores on this subscale is 5–35. The third subscale is Recognition of Gifts (RG)—awareness of the positive aspects of existence while considering them as gifts and implicitly attributing these gifts to a transpersonal agent (e.g., destiny, luck, nature, or divine providence). It includes the process that leads to the recognition of assets and their appraisal, as well as the social comparison that gives rise to the awareness of the positive aspects in one's life. This subscale has four items (e.g., "Every day I am aware that the little things in life that happen to me are a gift") and showed good reliability ($\alpha = 0.87$). The range of scores on this subscale is 4–28. The fourth subscale is Expression of Gratitude (EG): the experience and expression of gratitude toward transpersonal forces. Forms of expression can be verbal expression, rituals, and an attitude toward life of trying to be happy. This subscale has four items (e.g., "When I ask God or Fortune for help and I receive it, I usually remember those favors and give thanks") and showed acceptable reliability ($\alpha = 0.79$). The range of scores on this subscale is 4–28. The G20 obtained good reliability indices in its construction with a Spanish sample. Cronbach's alpha for each subscale was good and acceptable (IG $\alpha = 0.84$, GS $\alpha = 0.78$, RG $\alpha = 0.75$, EG $\alpha = 0.75$).

Ten-Item Personality Inventory (TIPI) (Gosling et al., 2003) is a 10-item measure of the Big-Five dimensions. Each item consists of two descriptors, separated by a comma, using the common stem, "I see myself as (i.e., extraverted, enthusiastic)". Each of the 10 items was rated on a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly). The TIPI takes about a minute to complete. The score is obtained from the sum of the two

TABLE 2 | Sociodemographic characteristics: employment status, educational level, and marital status.

Employment status	Percent	Educational level	Percent	Marital status	Percent
A homemaker	4.30	Bachelor's degree	42.38	Separated	4.30
A student	7.67	Doctorate degree	2.32	Single, never married	11.92
Other	1.99	Master's degree	14.24	Widowed	13.91
Out of work and looking for work	12.58	No schooling completed	16.56	Married or domestic partnership	47.02
Out of work but not currently looking for work	3.31	Professional degree	2.65	Divorced	12.25
Retired	14.90	Trade/technical/vocational training	21.85		
Salaried	34.11				
Self-employed	17.22				
Unable to work	3.97				

TABLE 3 | FC and gender co-occurrences.

	Better <i>n</i> (%)	No change <i>n</i> (%)	Worse <i>n</i> (%)	Σ <i>n</i> (%)
Man	10 (3.31)	64 (21.19)	75 (24.83)	149 (49.34)
Woman	10 (3.31)	62 (20.53)	81 (26.82)	153 (50.66)
Σ	20 (6.62)	126 (41.72)	156 (51.66)	302 (100)

items for each subscale after reversing an item in each of them. The range of scores for each subscale is 2–14. The Cronbach alphas in the original version were 0.68, 0.40, 0.50, 0.73, and 0.45 for the Extraversion (E), Agreeableness (A), Conscientiousness (C), Emotional Stability (ES), and Openness to Experience (OE) scales, respectively. Alpha Cronbach in this sample was 0.73, 0.43, 0.77, 0.81, and 0.46, respectively.

The Revised Purpose in Life questionnaire (PIL-R; Harlow et al., 1987) was revised from one developed by Crumbaugh (1968), based on Frankl's (1985) existential perspective. This work used the bifactorial version (García-Alandete et al., 2011) with two scales: Satisfaction and Sense of Life (SSL) with six items, four of which are reversed (i.e., "I am usually completely bored"), and Goals and Purposes in Life (GPL) with four items, two of which are reversed (i.e., "In life I have no goals or aims at all"). The bifactorial structure of García-Alandete et al. (2011) obtained good internal consistency, both for the scale ($\alpha = 0.86$) and for the factors ($\alpha = 0.84$ and $\alpha = 0.71$), respectively. Alpha Cronbach in this sample was 0.81 and 0.75, respectively. The PIL-R assesses the degree to which an individual has a sense of meaning or purpose in life. 7-point Likert scales ranging from "strongly disagree" (1) to "strongly agree" (7) are used to answer the items. Items refer to having goals or aims, life being empty or worthwhile, a sense of boredom or excitement, free will, despair, and sense of satisfaction with life. The score is obtained from the sum of the items for each subscale after reversing the items in each of them. The range of scores for each subscale is 6–42 (SSL) and 4–28 (GPL).

Brief Scale of Religiosity (BSR) (Bernabé-Valero et al., 2015) is a one-dimensional scale, comprising four items. It is a self-administered scale. Religious self-definition, degree of personal religiosity, frequency of attendance at worship and prayer, and importance of God in one's life are measured (i.e., "In terms of religion, I consider myself...": "1-Not religious at all" to "6-Extremely Religious"). No specific religious denomination is specified in the items. The response options are ordered from lesser to greater degree of religiousness with six levels of response (i.e., from "1-Not religious" to "6-Extremely religious"). The score is obtained from the sum of the four items and the scores range from 6 to 36. The Cronbach alphas in the original version were good ($\alpha = 0.89$) and very similar in this sample ($\alpha = 0.90$).

COVID-19's Impact Was Assessed Using the Following Two Instruments

The affective experience in the pandemic situation was assessed using the Positive Affects and Negative Affects Schedule (PANAS) (Watson and Clark, 1999). It's a comprehensive mood inventory originating from a dimensional approach to the understanding of emotion. It includes 10 items for Negative Affect (NA) and 10 items for Positive Affect (PA). Items are measured on a 5-point Likert scale, from "1-very slightly or not at all" to "5-extremely." In order to measure mood during the pandemic, we used the version PANAS-X (Past few weeks), in which the participants were asked to indicate to what extent they have felt this way over the past few weeks. The NA subscale comprises the following items: Distressed, Irritable, Jittery, Ashamed, Hostile, Guilty, Upset, Scared, Nervous, and Afraid. The PA subscale comprises the following items: Active, Enthusiastic, Determined, Attentive, Inspired, Strong, Interested, Alert, Excited, and Proud. Internal Consistency Reliabilities (Coefficient Alpha) in its construction were PA ($\alpha = 0.87$) and NA (0.87) for undergraduates, and PA ($\alpha = 0.86$) and NA (0.87) for employees. In the present study, the reliability is ($\alpha = 0.90$) in PA and ($\alpha = 0.91$) in NA. The score is obtained from the sum of the items

TABLE 4 | Spearman's Rank correlation coefficient between FC and personality variables.

	EX extraversion	AG agreeableness	CO conscientiousness	ES emotional stability	OE openness to experiences
Rho	-0.003	-0.086	-0.132	-0.339	-0.080
p-value	0.960	0.134	0.021	0.000	0.166

for each subscale. The range of scores for each subscale is 5–50.

Also, COVID-19 affectation was measured with the question: "We are currently in a worldwide pandemic situation due to COVID-19. Has this significantly affected your mood and emotions?" The three possible answers were: "Yes, I am feeling worse," "No, no change or almost no change," "Yes, I am better." We label this variable as "Facing COVID" (FC).

Statistical Analysis

Several tests were carried out in order to determine the relationships. Pearson's chi-squared test (χ^2) was carried out with dichotomous (gender) and ordinal variable (FC), Spearman's Rank Correlation Coefficient (rho) when the variable involved was FC (ordinal), and Pearson correlation coefficient (r) with metric variables. Student's *T*-test was used to explore the differences between men and women with metric variables.

With the aim of identifying whether there are different participant profiles with affectation of COVID-19 and target variables, several two-step cluster analyses were carried out with affectation of COVID-19 (FC and PANAS variables) and (i) age, (ii) gender, (iii) personality traits, (iv) positive and negative effects, (v) gratitude subscales, (vi) purpose in life subscales, and (vii) religiosity.

Since the cluster selection procedure is analytical, we proceeded to identify the quality of the clusters, mainly by looking at the "cluster quality" and "predictor importance" indicator in order to choose those that are useful for the research objectives. According to Kaufman and Rousseeuw (1990), a result in the fair zone means that the data give fair evidence of this cluster structure. The second most relevant indicator is the importance of the predictors, since, even if a cluster is good or fair, if there is only one predictor variable with high importance, the model is not useful, since the objective is to identify profiles with several variables. Therefore, clusters that meet at least two criteria are selected: (a) the criterion that the model has a fair or good outcome and (b) that at least two predictors have an importance >0.04 . In this sense, only three cluster analyses are accepted to continue with analysis: the cluster that includes the variables referring to COVID affectation together with gender, the cluster that includes the variables referring to COVID affectation and gratitude, and the cluster that includes the variables referring to COVID affectation and purpose in life.

Since the Kolmogorov-Smirnov test highlighted that the ordinal and metric variables did not have a normal distribution, the tests used to check the quality of the clusters selected were as follows: (i) Kruskal-Wallis *H*-test and Mann-Whitney *U*-test with Bonferroni correction ($\alpha = 0.005$ in cluster #1 and $\alpha =$

TABLE 5 | Pearson correlation coefficient between FC and positive and negative affects.

	PA positive affects	NA negative affects
Rho	-0.095	-0.042
p-value	0.098	0.465

0.017 in clusters #4 and #5) and (ii) χ^2 -test with variable gender (dichotomous) in cluster #1.

RESULTS

FC is not associated with gender $\chi^2_{(2)} = 0.210, p = 0.901$ (Table 3) and age $\rho = -0.068, p = 0.238$. Table 3 shows that 51.66% ($n = 156$) was marked "worse" in FC followed by: "no change" 41.72% ($n = 126$) and "better" 6.62% ($n = 20$). There are no value differences between men and women for FC. There are also no differences in gender with respect to affectivity: in PA (positive affects), $F_{(300)} = 0.148, p = 0.294$. For NA (negative affects), $F_{(300)} = 0.333, p = 0.316$.

FC is inversely correlated with all personality traits among -0.003 (EX) and -0.339 (ES) (see all rho values in Table 4). Only the correlations with ES and CO are significant.

There is no significant correlation between FC and PA and NA (Table 5). Positive Psychology variables (gratitude, purpose in life, and religiosity) also failed to obtain significant correlations with FC. The rho values are between 0.062 and -0.060 (see all rho values in Table 6).

Table 7 shows the associations for all the metric variables explored. The affective lived experience during the pandemic measured through the PANAS correlated significantly with most of the Positive Psychology variables (BSR, GI, GS, RG, EG, SSL, and GPL). Positive Affects (PA) were positively and significantly associated with the four subscales of Gratitude (IG, GS, RG, and EG), Satisfaction and Sense of Life (SSL), Goals and Purposes in Life (GPL), and Religiosity. PA had no significant associations with age and personality traits. NA obtained significant negative associations with the four subscales of Gratitude (IG, GS, RG, and EG), Satisfaction and Sense of Life (SSL), Goals and Purposes in Life (GPL), and Religiosity. It also has significant negative associations with age. There are not many high correlations between personality traits and the PANAS. Positive Affect (PA) was not associated with any personality trait; Negative Affect (NA) was only significantly and negatively associated with emotional stability. Pearson scores among Positive Psychology

TABLE 6 | Spearman's Rank Correlation Coefficient between FC and Positive Psychology variables.

	BSR religiosity	IG interpersonal gratitude	GS gratitude in the face of suffering	RG recognition of gifts	EG expression of gratitude scale	SSL satisfaction and sense of life	GPL goals and purposes in life
Rho	-0.058	0.033	-0.035	-0.042	-0.060	0.062	0.030
p-value	0.318	0.563	0.545	0.468	0.301	0.191	0.538

TABLE 7 | Pearson correlation coefficient between age, personality traits, Positive and Negative affects, and positive psychology variables.

	IG	GS	RG	EG	SSL	GPL	BSR	PA	NA	Age	E	A	C	ES
GS	<i>r</i> 0.473													
	<i>p</i> 0.000													
RG	<i>r</i> 0.584	0.753												
	<i>p</i> 0.000	0.000												
EG	<i>r</i> 0.351	0.539	0.594											
	<i>p</i> 0.000	0.000	0.000											
SSL	<i>r</i> -0.162	-0.085	-0.204	-0.073										
	<i>p</i> 0.005	0.142	0.000	0.207										
GPL	<i>r</i> 0.007	-0.017	-0.056	0.016	0.331									
	<i>p</i> 0.906	0.771	0.329	0.783	0.000									
BSR	<i>r</i> 0.209	0.336	0.335	0.720	-0.039	-0.013								
	<i>p</i> 0.000	0.000	0.000	0.000	0.498	0.825								
PA	<i>r</i> 0.268	0.496	0.519	0.404	-0.165	-0.050	0.229							
	<i>p</i> 0.000	0.000	0.000	0.000	0.004	0.385	0.000							
NA	<i>r</i> -0.200	-0.316	-0.371	-0.285	0.372	0.120	-0.147	-0.456						
	<i>p</i> 0.000	0.000	0.000	0.000	0.000	0.037	0.010	0.000						
Age	<i>r</i> 0.078	0.021	0.189	0.225	-0.287	-0.113	0.236	0.047	-0.266					
	<i>p</i> 0.179	0.721	0.001	0.000	0.000	0.052	0.000	0.420	0.000					
E	<i>r</i> -0.036	0.031	-0.039	-0.037	-0.103	0.053	-0.044	0.033	-0.072	0.054				
	<i>p</i> 0.533	0.597	0.496	0.516	0.075	0.358	0.445	0.573	0.213	0.349				
A	<i>r</i> -0.010	-0.048	-0.018	0.007	0.003	-0.087	0.025	-0.088	-0.026	0.202	0.170			
	<i>p</i> 0.867	0.407	0.755	0.910	0.957	0.132	0.661	0.127	0.657	0.000	0.003			
C	<i>r</i> -0.023	-0.050	-0.041	0.014	-0.150	0.007	0.055	0.058	-0.110	0.180	0.205	0.285		
	<i>p</i> 0.692	0.388	0.476	0.809	0.009	0.907	0.343	0.311	0.056	0.002	0.000	0.000		
ES	<i>r</i> 0.051	-0.004	0.025	0.018	-0.197	-0.058	0.018	0.085	-0.158	0.182	0.333	0.375	0.538	
	<i>p</i> 0.381	0.950	0.663	0.759	0.001	0.313	0.753	0.138	0.006	0.002	0.000	0.000	0.000	
OE	<i>r</i> -0.007	-0.031	-0.010	0.042	-0.063	-0.094	-0.047	0.031	-0.049	0.118	0.363	0.313	0.196	0.303
	<i>p</i> 0.906	0.597	0.858	0.472	0.276	0.104	0.419	0.588	0.392	0.041	0.000	0.000	0.001	0.000

variables are between -0.197 and 0.753 , where there are only two notable correlations: Gratitude Expression and Religiosity (0.720) and Recognition of Gifts and GS (0.753) followed below by four correlations scoring between 0.5 and 0.6 .

Table 8 shows the main indicators for each cluster analysis performed. More information is available in **Appendix 1**.

The first selected cluster analysis included the variables of COVID affectation and gender. The five obtained clusters are described below:

Cluster #1 comprises 26.8% of the participants ($N = 81$), 100% belong to the category "worse" in their COVID-19 affect, and 100% are women with medium-high scores in positive affect (mean = 43.26) and medium-low scores in negative affect (mean = 21.22). They are "women worse in COVID medium affect."

Cluster #2 comprises 6.6% of the participants ($n = 20$), 100% belong to the category "better" in their COVID-19 affect, 50% are female and 50% are male, and their scores are high in positive affect (mean = 46.15) and medium-low in negative affect (mean = 18.10). They are labeled as "best mixed gender group in COVID-19 good affect."

Cluster #3 comprises 20.5% of the participants ($N = 62$), 100% belong to the category "no change" in their COVID-19 affect, and 100% are women with high scores in positive affect (mean = 46.71) and low scores in negative affect (mean = 19.44). They are labeled as "women with no change in COVID good affect."

Cluster #4 comprises 21.2% of the participants ($N = 64$), 100% belong to the category "no change" in their COVID-19 affect, and 100% are men with high scores on positive affect (mean =

TABLE 8 | Clusters FC and positive and negative affects with age, gender, personality traits, gratitude, purpose in life, and religiosity.

Set of variables included in the clusters two-steps analysis (inputs)	Cluster quality (poor. fair. good)	Average silhouette measure of cohesion and separation	Number of clusters	Ratio of sizes of clusters	Feature importance	Utility decision
FC+ PA+ NA+ gender	Fair	0.5	5	4.05	1; 0.47; 0.01; 0.00	selected
FC+ PA+ NA+ age	Fair	0.3	2	1.02	1; 0.01; 0.01; 0.01	rejected
FC+ PA+ NA+ Personality traits (E+A+C+ES+OE)	Fair	0.3	2	1.40	1; 0.12; 0.03; 0.01; 0.0	rejected
FC+ PA+ NA+ Gratitude (IG+GS+RG+EG)	Fair	0.3	3	2.58	1; 0.92; 0.58; 0.53; 0.23; 0.27; 0.11	selected
FC+ PA+ NA+ +Purpose in Life (SSL+GPL)	Fair	0.3	2	1.40	1; 0.01; 0.01; 0.0; 0.0	selected
FC+ PA+ NA+ Religiosity (BSR)	Fair	0.3	2	1.07	1; 0.01; 0.01; 0.01	rejected

TABLE 9 | Mann-Whitney *U*-test in variables of second selected cluster analysis.

Clusters	IG (<i>U</i> <i>p</i>)	GS (<i>U</i> <i>p</i>)	RG (<i>U</i> <i>p</i>)	EG (<i>U</i> <i>p</i>)	PA (<i>U</i> <i>p</i>)	NA (<i>U</i> <i>p</i>)	FC (<i>U</i> <i>p</i>)
#1–#2	851.5 0.000	480 0.000	185.5 0.000	785 0.000	1.009 0.000	1.668.5 0.000	1.695.5 0.000
#1–#3	757 0.000	426 0.000	202 0.000	1.036 0.000	1.283.5 0.000	1.913 0.000	1.741.5 0.000
#2–#3	757 0.470	426 0.771	202 0.506	1.036 0.171	1.283.5 0.090	1.913 0.481	1.741.5 0.000

TABLE 10 | Mann-Whitney *U*-test in variables of third selected cluster analysis.

Clusters	PA (<i>U</i> <i>p</i>)	NA (<i>U</i> <i>p</i>)	FC (<i>U</i> <i>p</i>)	SSL (<i>U</i> <i>p</i>)	GPL (<i>U</i> <i>p</i>)
#1–#2	1,005.5 0.000	1,070.5 0.000	2,074 0.000	519 0.000	787.5 0.000
#1–#3	5,444.5 0.013	6,383.5 0.521	0 0.000	5,804.5 0.075	5,941.5 0.131
#2–#3	541 0.000	792.5 0.000	2,058 0.000	287 0.000	489 0.000

47.19) and low scores on negative affect (mean = 19.44). They are labeled as “men with no change in COVID affect.”

Cluster #5 comprises 24.8% of the participants ($N = 75$), 100% belong to the category “worse” in their COVID-19 affect, and 100% are men with medium-high scores on positive affect (mean = 45.92) and low scores on negative affect (mean = 18.69). They are labeled as “men worse in COVID medium-positive affect.”

Kruskal-Wallis *H*-test indicates significant differences for FC ($p < 0.001$) in the first selected cluster analysis, while PA $p = 0.141$ and NA $p = 0.346$. Mann Whitney *U*-test in FC indicates that all differences between clusters are significant ($U < 0.001$, $p < 0.001$) except between clusters #1 and #5 ($U = 3,034$, $p = 1.000$) and #3 and #4 ($U = 1,984$, $p = 1.000$). χ^2 -test for gender and first cluster analysis shows the relationship between these variables [$\chi^2_{(4)} = 278.045$, $p < 0.001$].

The second selected cluster analysis included the variables of COVID affectation and gratitude variables. The three obtained clusters are described below:

Cluster #1 ($n = 50$, 16.6%) comprises 54% of participants who report feeling worse since the pandemic started, the remaining 46% are distributed between no change (32%) and better (14%). In gratitude, they obtained medium scores in RG (mean = 16.32),

medium-high scores in IG (mean = 36.22), and low scores in GS (mean = 16.56) and EG (mean = 10.68). In relation to affect, they obtain medium-low scores in positive affect (mean = 35.08) and medium-high scores in negative affect (mean = 25.24). We will label it as “mixed on medium gratitude and medium affect.”

Cluster #2 ($n = 123$, 40.7%) comprises 89.4% of participants reporting no change since the pandemic started and the remaining 10.6% are better. In gratitude they score high on RG (mean = 25.08) and IG (mean = 43.91), medium-high on GS (mean = 28.14), and medium on EG (mean = 18.91). In relation to affect, they scored high in positive affect (mean = 48.51) and low in negative affect (mean = 18.91). We will label it as “no COVID affect, medium-high gratitude, and good affect.”

Cluster #3 ($n = 129$, 42.7%) comprises 100% of participants who report being worse since the pandemic started. In gratitude they scored high on RG (mean = 24.85) and IG (mean = 44.32) and medium-high on GS (mean = 28.12) and medium on EG (17.95). In relation to affect, they scored high in positive affect (mean = 46.54) and low in negative affect (mean = 18.88). We will label it as “COVID negative affect, medium-high gratitude, and good affectivity.”

Kruskal–Wallis H -test indicates significant differences ($p < 0.001$) in IG, GS, RG, EG, PA, NA, and FC variables in the second selected cluster analysis. Mann Whitney U -test (Table 9) shows that all differences between clusters are significant ($p < 0.001$) for all variables, except between clusters #2 and #3 for the variables IG, GS, RG, EG, PA, and NA ($p > 0.08$).

The third selected cluster analysis included the variables of COVID affectation and purpose in life variables. The three obtained clusters are described below:

Cluster #1 ($n = 122$, 40.4%) comprises 100% of participants who report being worse since the pandemics started. In purpose in life, they obtained high scores in SSL (mean = 32.88) and in GPL (mean = 22.48); in relation to affect, they obtained high scores in PA (mean = 47.73) and low scores in NA (mean = 17.20). We will label it as “worse in COVID, good purpose in life, and good affectivity.”

Cluster #2 ($n = 70$, 23.2%) comprises 48.6% of participants who report being worse since the pandemic started, the remaining 51.4% are distributed between no change (41.4%) and better (10%). In purpose in life, they obtained medium-low scores in SSL (mean = 21.57) and in GPL (mean = 14.77). In relation to affect, they obtained medium-low scores in positive affect (mean = 33.51) and medium-high scores in negative affect (mean = 29.01). We will label it as “mixed on facing COVID, medium-low purpose in life, and medium affect.”

Cluster #3 ($n = 110$, 36.4%) comprises 87.3% participants reporting no change since the pandemic started, and the remaining 12.7% are better. In purpose in life, they obtained high scores in SSL (mean = 33.95) and in GPL (mean = 23.23); in relation to affect, they obtained high scores in PA (mean = 49.51) and low scores in NA (mean = 16.38). We will label it as “worse in COVID, good purpose in life, and good affectivity.”

Kruskal–Wallis H -test indicates significant differences ($p < 0.001$) in SSL, GPL, PA, NA, and FC variables in the third selected cluster analysis. Mann Whitney U -test (Table 10) shows that all differences between clusters are significant ($p < 0.017$) for all variables, except between clusters #1 and #3 for the variables SSL, GPL, and NA ($p > 0.06$).

DISCUSSION AND CONCLUSION

Possible consequences of the COVID-19 pandemic are rather unpredictable; studies conducted during the pandemic allow us to explore the short-term impact of the pandemic and to identify new factors that influence global health. Specifically, we have explored the factors that may influence the subjective perception of the emotional and behavioral impact of COVID-19.

In relation to age, this study found an inverse association between negative affect and age, indicating that the older the age, the lower the negative affect scores. Along the same lines, other studies found older people had better well-being scores than younger people (e.g., Bidzan-Bluma et al., 2020). However, in this study, age did not have significant relationships with positive affect and was not associated with facing COVID-19. In this regard, Ebert et al. (2020), in a study with a comparable sample to our study (participants from crowdsourcing platform, MTurk),

found mean age differences were observed, but the trajectory of change did not differ by age. This suggests that responses to COVID-19 may be age-invariant and that effects on well-being are not immediate, but that they may emerge over a longer period of time. For our part, we believe that the most noticeable age-related changes may be in negative affect, as people may learn to manage their emotional distress throughout their life. However, it seems that the activation of positive emotions and the categorization of facing COVID is invariant with age.

Gender also did not show differences in COVID-19 affectation; the three facing COVID-19 groups display similar percentages in men and women. Differences in positive and negative affect have also not been found. In this sense, these results are in addition to those papers in which no differences were found between men and women in terms of COVID-19 affectation (Cao et al., 2020; Huang and Zhao, 2020; Zhang and Ma, 2020) and contrast the outcomes where women are more negatively affected (Rogowska et al., 2020; Tan et al., 2020; Wang et al., 2020). However, the cluster analysis allowed us to find differences between the groups obtained according to gender. Thus, of the five clusters obtained, two clusters (cluster 3 and 4) are similar in all variables, although cluster 3 is composed entirely of women and cluster 4 is composed entirely of men. Cluster 2, on the other hand, is equally mixed in terms of gender, so it does not indicate differences between men and women. Thus, the results of this study could be consistent with the findings above: there are profiles of participants in which they are gender invariant (those who indicated that they did not notice changes since the pandemic started and those who indicated that they were better), and there are other profiles (those who indicated that they were worse) in which there is a gender difference, in the sense that women are more negatively affected. These results have important implications for research because they demonstrate the relevance of classifying participants into profiles, thus further clarifying results when contradictory results were found in previous literature. In sum, more research is needed regarding age and gender as well as controlling labor and childcare variables, since these could be factors affecting well-being in a period of lockdown and crisis.

In relation to personality traits, the results are in line with other COVID-19 studies that show how emotional stability was inversely related to COVID-19 affectation (Aschwanden et al., 2020; Gubler et al., 2020) and with negative affect. Emotionally unstable individuals (i.e., individuals with high levels of neuroticism) have more dysfunctional interpersonal relationships and are less satisfied with their relationships, experience fear, depression, and guilt more often than emotionally stable individuals, and are more sensitive to social rejection cues. Additionally, higher conscientiousness was associated negatively with COVID-19 affectation. This result aligns with previous research that found individuals with a high conscientiousness took more precautions to avoid catching coronavirus (Aschwanden et al., 2020). This circumstance may have influenced the impact of the pandemic, since new behavioral habits aimed at preventing infection have been acquired, which has influenced their adaptation. Thus, the research of personality traits and coping with the COVID-19 pandemic is an emerging

research area that can help advise public healthcare policy recommendations, taking into account personality traits and their response to healthcare.

On the other hand, gratitude, purpose in life, and religiosity did not obtain associations with facing COVID-19. However, these three constructs were significantly related to positive and negative affect experienced during the pandemic.

Specifically, the results reveal that all four subscales of gratitude were positively associated with positive affect and inversely associated with negative affect, indicating that people who are more grateful, both to other people and to transcendental forces, experience a better affective experience. This result is consistent with previous studies in which gratitude was related to various dimensions of well-being, conducted throughout the COVID-19 pandemic (e.g., Burke et al., 2020; Jiang, 2020), in other historical times of adversity (e.g., Coffman, 1996; Peterson and Seligman, 2003), and also in normative historical times (e.g., Mairean et al., 2019). However, the four subscales of gratitude were not related to FC. We suggest that this result could be due to the specificity of the measure, which asks specifically about the experience of COVID-19 and not about the general state of personal well-being. Along the same lines, we found the results of a study in which a scale was designed specifically for the COVID-19 situation. It included nine gratitude items and the participants were asked, "In the past month, how much has your experience of the COVID-19 crisis led you to feel grateful for the following things?" The results did not reveal significant associations between their COVID-19 specific gratitude scale and scores on depression, anxiety, and stress, but they did find significant associations with personal well-being and with their perception of COVID-19 (Burke et al., 2020). These results show us the importance of taking great care in interpreting the results in terms of the specificity of the measure, in order to be able to differentiate accurately whether gratitude is measured at the trait level or whether gratitude is measured for specific situations, as different patterns of associations may emerge for different specifications of gratitude. In any case, these results show the importance in affectivity of the two types of gratitude measured (interpersonal and transcendental), and the different processes it involves (gratitude in the face of suffering, re-conception of gifts and expression of gratitude). Of particular note is the novel facet of gratitude used in this study on gratitude in the face of suffering, which allows us to value gratitude in spite of adversity. This facet has even obtained higher correlations with PA and NA than interpersonal gratitude, a facet that is usually associated to a greater extent with well-being, because it affects interpersonal relationships. It may be that in times of adversity, such as a global pandemic, this facet of gratitude could play an important role in maintaining a good affective experience.

In addition, gratitude was one of the constructs studied that allowed us to classify the participants into profiles according to their COVID affect. Thus, the three clusters resulting from the analysis show that cluster 2, labeled as "no COVID affect, medium-high gratitude, and good affect" and cluster 3, labeled as "negative COVID affect, medium-high gratitude, and good affect" indicate good indices of gratitude and good affect (characterized by high scores on positive affect and low

scores on negative affect). That is, the only difference was that participants in cluster 3 responded that they were "worse" in relation to the pandemic, and those in cluster 2 experienced "no change" or were "better," but the scores in both groups on Positive Affect (PA) and Negative Affect (NA) and gratitude were similar, indicating good gratitude and good affectivity. There are several possible explanations for this: it could be that cluster 3 participants had higher previous levels of affectivity and that, in the face of the COVID-19, their affective experience worsened, now equating to the affectivity of cluster 2 participants, whose previous levels of affectivity could be similar to those obtained during the pandemic, this being congruent with their "no change" response. In other words, from this explanation, very high basal levels of affectivity might decrease in the face of the pandemic and match high levels, while high basal levels might be maintained. Another possible explanation could be related to response biases, specifically related to the global-specificity of cognitive judgements; some people might be more congruent between their global judgements about their emotional-affective experience in relation to judgements of affect and concrete experiences (measured, for example, with the PANAS and G20 questionnaires), while others might opt for a global judgement that overestimates or underestimates their concrete affective experience, thus not corresponding to both measures. Research has studied this relationship and has found that specific judgments were slightly more accurate than global judgments (Karst et al., 2018).

In this sense, cluster 1, labeled as "mixed in facing COVID, medium gratitude, and medium affectivity" does differ from the other clusters with lower values for gratitude and affectivity (less positive affect and more negative affect). It is worth noting that cluster 1 is made up of a mixture of participants who responded that they were "worse," "no change," and "better" in relation to the pandemic. Thus, in the group of participants with worse affect, 14% of them indicated that they felt better over the period of the pandemic, which could be an overestimation as a strategy to enhance well-being and resilience. This optimistic view may represent an adaptive "distortion" of reality that fosters people's mental health (Colombo et al., 2020). Thirty-two percent of participants indicated that they had not noticed changes in the pandemic, although they scored medium on gratitude and PA and higher on NA than the other two clusters. Regarding this connection, a previous study showed that the presence of mild depressive symptoms led participants to a greater overestimation of NA and higher underestimation of PA (Colombo et al., 2019). This could be the case for this group of participants, whose affectivity is worse and who cannot enjoy the potential benefits of gratitude. In any case, and despite the biases, what is clear is that participants can be grouped into two distinct profiles in relation to gratitude: those with good affect who have high scores on gratitude, and those with medium-low scores on positive affect and medium-high scores on negative affect with medium gratitude. These results could be interpreted because grateful people value acts of altruism, help, and sacrifice that have been experienced during the COVID-19 pandemic and may reinforce belief in positive human nature, leading to a better affective experience. Thus, gratitude emerges as a strength that

can be promoted through interventions and thus increase, for example, happiness (Dickens, 2017), well-being (e.g., Wood et al., 2010; Rash et al., 2011), and physical health (Boggiss et al., 2020). For example, during the pandemic, the Department of Surgery at the University of California, San Francisco (UCSF) implemented the “Gratitude and Good Outcomes” program with the purpose of allowing Department members to publicly express gratitude and to highlight and celebrate examples of outstanding teamwork and surgical skill, as demonstrated by our surgeons and their teams. This demonstrates the effectiveness of taking some time to recognize and celebrate good work, which should be an essential component of clinician training and practice, thus providing care tools for such an important professional sector in times of a pandemic. Additionally, in the field of education, evidence has been found that programs aimed at increasing trait gratitude in adolescents improved well-being for 6 weeks after said interventions (Bono et al., 2020b). Thus, the development of gratitude is configured as a strategy with very important practical implications in various contexts, such as health and education.

In relation to purpose in life, this was not related to FC, but it did have significant positive associations with PA. Similarly, studies such as that by Trzebiński et al. (2020) found that high meaning in life and life satisfaction, as well as strong presumptions on orderliness and positivity of the world, correlate with fewer panic thoughts and emotions evoked by the apparent danger of the ongoing COVID-19 pandemic. On the other hand, NA was also positively and significantly associated with the two subscales of PIL. Previous studies have found that the purpose of life has been related to greater well-being (e.g., Işık and Üzbe, 2015), more positive affect, and less negative affect. However, it is suggested that psychological interventions aimed at re-signifying experiences and finding new meaning in their lives could help to cushion the negative effects of the pandemic situation. For example, it has been proposed that life crafting interventions could offer a way to help people cope and renew their sense of life (De Jong et al., 2020). In relation to the cluster analysis between purpose in life and COVID affectation, three clusters are obtained with the same structure as the clusters obtained with the gratitude variables, in which the group with the worst affectivity and meaning of life, categorizes—in a biased way—COVID affectation, while another group that indicates that it feels worse since the pandemic, obtained good affectivity. We assume the same aforementioned argument in relation to the influence of affect on response biases.

With regard to religiosity and COVID affectation, the results show that there is no relationship in terms of FC, but significant associations were obtained with PA in a positive way and with inverse NP. These results are in line with previous research, such as that by Lucchetti et al. (2020) who found—in a sample from Brazil—that lower levels of worrying in the pandemic were associated with greater private religious activities, religious attendance, spiritual growth, and with an increase in religious activities; lower levels of fear were associated with greater private religious activities and spiritual growth. Lower levels of sadness were associated with spiritual growth. Another study also found

that the well-being of tumor patients during the pandemic was predicted by a mix of disease and pandemic related stressors, and by available resources such as meaning in life and religious trust (Büssing et al., 2020). Thus, religiosity could be a buffer for stressors in the pandemic, although more research is needed, for example, on specific confessionality and a cross-cultural approach to further delineate these relationships.

Moreover, this study found significant associations between gratitude, purpose in life, and religiosity, similar to other studies conducted in non-pandemic times (e.g., Bernabé Valero, 2012). These results suggest that the underlying patterns of human strength relationships are maintained despite adverse situations, such as COVID-19. In this way, psychologists and researchers could take these relational patterns into account when designing interventions aimed at enhancing each strength and improving the affective experience.

In summary, the results of this paper have important implications for research, which have been developed throughout this discussion, as they alert us to potential biases in the measurement of affectivity and encourage future work to consider baseline levels of affect and to use multi-method and multi-source strategies to control for such biases. Similarly, another limitation of this study is the cross-sectional design that does not allow for the assessment of changes over time. Nevertheless, our results corroborate the importance of further research on the identification of individual differences to guide public health policy decisions and the actions of physical and mental health professionals.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Materials**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Universidad Católica de Valencia San Vicente Mártir committee (number UCV2017-2018-28). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GB-V conceived the presented idea. GB-V, DM-F, ID, and MG developed the theory and performed the computations. All authors discussed the results and contributed to the final manuscript.

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REFERENCES

- Ammar, A., Chtourou, H., Boukhris, O., Trabelsi, K., Masmoudi, L., Brach, M., et al. (2020). COVID-19 home confinement negatively impacts social participation and life satisfaction: a worldwide multicenter study. *Int. J. Environ. Res. Public Health* 17:6237. doi: 10.3390/ijerph17176237
- Arslan, G., Yildirim, M., and Wong, P. T. P. (2020). Meaningful living, resilience, affective balance, and psychological health problems during COVID-19. *PsyArXiv*. doi: 10.31234/osf.io/wsr3e
- Aschwanden, D., Strickhouser, J. E., Sesker, A. A., Lee, J. H., Luchetti, M., Stephan, Y., et al. (2020). Psychological and behavioural responses to coronavirus disease 2019: the role of personality. *Eur. J. Personal.* doi: 10.1002/per.2281. [Epub ahead of print].
- Bentzen, J. (2020). *In Crisis, We Pray: Religiosity and the COVID-19 Pandemic*. Available online at: https://www.researchgate.net/publication/343627578_In_Crisis_We_Pray_Religiosity_and_the_COVID-19_Pandemic
- Bernabé Valero, M. G. (2012). *La gratitud como actitud existencial: papel predictivo de la religiosidad, la espiritualidad y el sentido de la vida* (Tesis Doctoral). Universidad Católica de Valencia San Vicente Mártir, Valencia.
- Bernabe-Valero, G., Blasco-Magraner, J. S., and García-March, M. R. (2020). Gratitude questionnaire-20 items (G20): a cross-cultural, psychometric and crowdsourcing analysis. *Front. Psychol.* 11:626330. doi: 10.3389/fpsyg.2020.626330
- Bernabé-Valero, G., García-Alandete, J., and Gallego-Pérez, J. F. (2014). Construcción de un cuestionario para la evaluación de la gratitud: el Cuestionario de Gratitud-20 ítems (G-20). *Ann. Psychol.* 30, 278–286. doi: 10.6018/analesps.30.1.135511
- Bernabé-Valero, G., Moret-Tatay, C., and García-Alandete, J. (2015). Análisis confirmatorio de una escala para la medida de la religiosidad: la Escala Breve de Religiosidad (EBR). *Psiquiatría. com.* 1:28. Available online at: <https://psiquiatria.com/bibliopsiquis/volumen.php?wurl=análisis-confirmatorio-de-una-escala-para-la-medida-de-la-religiosidad-la-escala-breve-de-religiosidad-eb>
- Bidzan-Bluma, I., Bidzan, M., Jurek, P., Bidzan, L., Knietzsch, J., Stueck, M., et al. (2020). A polish and German population study of quality of life, well-being, and life satisfaction in older adults during the COVID-19 pandemic. *Front. Psychiatry* 11:585813. doi: 10.3389/fpsyg.2020.585813
- Boggiss, A. L., Considine, N. S., Brenton-Peters, J. M., Hofman, P. L., and Serlachius, A. S. (2020). A systematic review of gratitude interventions: effects on physical health and health behaviors. *J. Psychosom. Res.* 135:110165. doi: 10.1016/j.jpsychores.2020.110165
- Bono, G., Emmons, R. A., and McCullough, M. E. (2004). "Gratitude in practice and the practice of gratitude," in *Positive Psychology in Practice*, eds P. A. Linley and S. Joseph (John Wiley & Sons, Inc), 464–481.
- Bono, G., Mangan, S., Fauteux, M., and Sender, J. (2020a). A new approach to gratitude interventions in high schools that supports student wellbeing. *J. Posit. Psychol.* 15, 657–665. doi: 10.1080/17439760.2020.1789712
- Bono, G., Reil, K., and Hescoux, J. (2020b). Stress and wellbeing in college students during the COVID-19 pandemic: can grit and gratitude help? *Int. J. Wellbeing* 10, 39–57. doi: 10.5502/ijw.v10i3.1331
- Burke, T., Berry, A., Taylor, L. K., Stafford, O., Murphy, E., Shevlin, M., et al. (2020). Increased psychological distress during COVID-19 and quarantine in Ireland: a national survey. *J. Clin. Med.* 9:3481. doi: 10.3390/jcm9113481
- Büssing, A., Hübner, J., Walter, S., Gießler, W., and Büntzel, J. (2020). Tumor patients' perceived changes of specific attitudes, perceptions, and behaviors due to the COVID-19 pandemic and its relation to reduced wellbeing. *Front. Psychiatry* 11:574314. doi: 10.3389/fpsyg.2020.574314
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287:112934. doi: 10.1016/j.psychres.2020.112934
- Coffman, S. (1996). Parents' struggles to rebuild family life after hurricane Andrew. *Issues Ment. Health Nurs.* 17, 353–367. doi: 10.3109/01612849609009406
- Colombo, D., Suso-Ribera, C., Fernández-Álvarez, J., Cipresso, P., García-Palacios, A., Riva, G., et al. (2020). Affect recall bias: being resilient by distorting reality. *Cognit. Ther. Res.* 44, 906–918. doi: 10.1007/s10608-020-10122-3
- Colombo, D., Suso-Ribera, C., Fernández-Álvarez, J., Felipe, I. F., Cipresso, P., Palacios, A. G., et al. (2019). "Exploring affect recall bias and the impact of mild depressive symptoms: an ecological momentary study," in *Pervasive Computing Paradigms for Mental Health*, eds P. Cipresso, S. Serino, and D. Villani (New York, NY: Springer International Publishing), 208–215.
- Crumbaugh, J. C. (1968). Cross-validation of purpose-in-life test based on Frankl's concepts. *J. Individ. Psychol.* 24:74. doi: 10.1037/t01175-000
- De Jong, E. M., Ziegler, N., and Schippers, M. C. (2020). From shattered goals to meaning in life: Life crafting in times of the COVID-19 pandemic. *Front. Psychol.* 11:2648. doi: 10.3389/fpsyg.2020.577708
- Dickens, L. R. (2017). Using gratitude to promote positive change: a series of meta-analyses investigating the effectiveness of gratitude interventions. *Basic Appl. Soc. Psych.* 39, 193–208. doi: 10.1080/01973533.2017.1323638
- Ebert, A. R., Bernstein, L. E., Carney, A. K., and Patrick, J. H. (2020). Emotional well-being during the first four months of COVID-19 in the United States. *J. Adult Dev.* 27, 241–248. doi: 10.1007/s10804-020-09365-x
- Fitzgerald, P. (1998). Gratitude and justice. *Ethics* 109, 119–153. doi: 10.1086/233876
- Frankl, V. E. (1985). *Man's Search for Meaning*. New York, NY: Simon and Schuster.
- Fredrickson, B. L., Tugade, M. M., Waugh, C. E., and Larkin, G. R. (2003). What good are positive emotions in crisis? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *J. Pers. Soc. Psychol.* 84, 365–376. doi: 10.1037/0022-3514.84.2.365
- García-Alandete, J., Martínez, E. R., Soucase Lozano, B., and Gallego-Pérez, J. F. (2011). Diferencias asociadas al sexo en las puntuaciones total y factoriales del Purpose-In-Life Test en universitarios españoles. *Universitas Psychol.* 10, 681–692. doi: 10.11144/Javeriana.upsy10-3.dasp
- Gosling, S. D., Rentfrow, P. J., and Swann, W. B. Jr. (2003). A very brief measure of the Big-Five personality domains. *J. Res. Pers.* 37, 504–528. doi: 10.1016/S0092-6566(03)00046-1
- Gubler, D. A., Makowski, L. M., Troche, S. J., and Schlegel, K. (2020). Loneliness and well-being during the Covid-19 pandemic: associations with personality and emotion regulation. *J. Happiness Stud.* doi: 10.1007/s10902-020-00326-5. [Epub ahead of print].
- Harlow, L. L., Newcomb, M. D., and Bentler, P. M. (1987). Purpose in Life Test assessment using latent variable methods. *Br. J. Clin. Psychol.* 26, 235–236. doi: 10.1111/j.2044-8260.1987.tb01355.x
- Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 288:112954. doi: 10.1016/j.psychres.2020.112954
- İşik, S., and Üzbe, N. (2015). Personality traits and positive/negative affects: an analysis of meaning in life among adults. *Educ. Sci. Theory Prac.* 15, 587–595. doi: 10.12738/estp.2015.3.2436
- Jiang, D. (2020). Feeling gratitude is associated with better well-being across the life span: a daily diary study during the COVID-19 outbreak. *J. Gerontol. Ser. B.* doi: 10.1093/geronb/gbaa220. [Epub ahead of print].
- Karst, K., Dotzel, S., and Dickhäuser, O. (2018). Comparing global judgments and judgments of teachers about students' knowledge: Is the whole the sum of its parts? *Teach. Teach. Educ.* 76, 194–203. doi: 10.1016/j.tate.2018.01.013
- Kashdan, T. B., Uswatte, G., and Julian, T. (2006). Gratitude and hedonic and eudaimonic well-being in Vietnam war veterans. *Behav. Res. Ther.* 44, 177–199. doi: 10.1016/j.brat.2005.01.005

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.644286/full#supplementary-material>

- Kaufman, L. and Rousseeuw, P. J. (Eds.) (1990). *Finding Groups in Data: An Introduction to Cluster Analysis*. New York, NY: John Wiley and Sons.
- Kowal, M., Coll-Martin, T., Ikizer, G., Rasmussen, J., Eichel, K., Studzinska, A., et al. (2020). Who is the most stressed during the COVID-19 pandemic? Data from 26 countries and areas. *Appl. Psychol. Health Well Being* 12, 946–966. doi: 10.1111/aphw.12234
- Kranz, D., Niepel, C., Botes, E., and Greiff, S. (2020). Religiosity predicts unreasonable coping with COVID-19. *Psychol. Religion Spiritual.* doi: 10.1037/rel0000395
- Lucchetti, G., Góes, L. G., Amaral, S. G., Ganadjian, G. T., Andrade, I., Almeida, P., et al. (2020). Spirituality, religiosity and the mental health strengths of social isolation during Covid-19 pandemic. *Int. J. Soc. Psychiatry.* doi: 10.1177/0020764020970996. [Epub ahead of print].
- Mairean, C., Turliuc, M. N., and Arghire, D. (2019). The relationship between trait gratitude and psychological wellbeing in university students: the mediating role of affective state and the moderating role of state gratitude. *J. Happiness Stud.* 20, 1359–1377. doi: 10.1007/s10902-018-9998-7
- Martínez-Martí, M. L., Theirs, C. I., Pascual, D., and Corradi, G. (2020). Character strengths predict an increase in mental health and subjective well-being over a one-month period during the COVID-19 pandemic lockdown. *Front. Psychol.* 11:584567. doi: 10.3389/fpsyg.2020.584567
- Modersitzki, N., Phan, L., Kuper, N., and Rauthmann, J. F. (2020). Who is impacted? Personality predicts individual differences in psychological consequences of the COVID-19 pandemic in Germany. *Soc. Psychol. Personal. Sci.* doi: 10.31234/osf.io/s65ux
- Nowicki, G. J., Slusarska, B., Tucholska, K., Naylor, K., Chrzan-Rodak, A., and Niedorys, B. (2020). The severity of traumatic stress associated with COVID-19 pandemic, perception of support, sense of security, and sense of meaning in life among nurses: research protocol and preliminary results from Poland. *Int. J. Environ. Res. Public Health* 17:6491. doi: 10.3390/ijerph17186491
- Peterson, C., and Seligman, M. E. (2003). Character strengths before and after September 11. *Psychol. Sci.* 14, 381–384. doi: 10.1111/1467-9280.24482
- Rash, J. A., Matsuba, M. K., and Prkachin, K. M. (2011). Gratitude and well-being: who benefits the most from a gratitude intervention? *Appl. Psychol. Health Well Being* 3, 350–369. doi: 10.1111/j.1758-0854.2011.01058.x
- Rogowska, A. M., Kuśnierz, C., and Bokszczanin, A. (2020). Examining anxiety, life satisfaction, general health, stress and coping styles during COVID-19 pandemic in Polish sample of university students. *Psychol. Res. Behav. Manag.* 13, 797–811. doi: 10.2147/PRBM.S266511
- Sun, N., Wei, L., Shi, S., Jiao, D., Song, R., Ma, L., et al. (2020). A qualitative study on the psychological experience of caregivers of COVID-19 patients. *Am. J. Infect. Control.* 48, 592–598. doi: 10.1016/j.ajic.2020.03.018
- Tan, Y., Lin, X., Wu, D., Chen, H., Jiang, Y., He, T., et al. (2020). Different trajectories of panic and the associated factors among unmarried Chinese during the COVID-19 pandemic. *Appl. Psychol. Health Well Being* 12, 967–982. doi: 10.1111/aphw.12238
- Trzebiński, J., Cabański, M., and Czarnecka, J. Z. (2020). Reaction to the COVID-19 pandemic: the influence of meaning in life, life satisfaction, and assumptions on world orderliness and positivity. *J. Loss Trauma* 25, 544–557. doi: 10.1080/15325024.2020.1765098
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17:1729. doi: 10.3390/ijerph17051729
- Watson, D., and Clark, L. A. (1999). The PANAS-X: Manual for the positive and negative affect schedule-expanded form.
- Wood, A. M., Froh, J. J., and Geraghty, A. W. (2010). Gratitude and well-being: a review and theoretical integration. *Clin. Psychol. Rev.* 30, 890–905. doi: 10.1016/j.cpr.2010.03.005
- Zhang, Y., and Ma, Z. F. (2020). Impact of the COVID-19 pandemic on mental health and quality of life among local residents in Liaoning Province, China: a cross-sectional study. *Int. J. Environ. Res. Public Health* 17:2381. doi: 10.3390/ijerph17072381
- Zheng, L., Miao, M., and Gan, Y. (2020). Perceived control buffers the effects of the COVID-19 pandemic on general health and life satisfaction: the mediating role of psychological distance. *Appl. Psychol. Health Well Being* 12, 1095–1114. doi: 10.1111/aphw.12232

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The Relationship Between Quarantine Length and Negative Affect During the COVID-19 Epidemic Among the General Population in China: The Roles of Negative Cognition and Protective Factors

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Quarantine and isolation at extended length, although considered as highly effective countermeasures for the novel coronavirus (COVID-19) which started at the end of 2019, can have great impact on individual's mental health, especially emotional state. The present research recruited 5,115 participants from the general public across 32 provinces and autonomous regions in China in an online survey study, about 20 days after the lockdown of the epicenter (Wuhan), to investigate the relationship between the length of the quarantine and negative affect (including depression and anxiety), as well as the mediating roles of negative cognition (including worry and anticipation), and the moderating roles of dispositional optimism, tolerance of uncertainty, social support, and healthy behavior. The results showed that: (1) Worry and anticipation mediated the relationship between quarantine length and depression and anxiety; (2) Dispositional optimism moderated the path coefficients of quarantine length to worry, worry to anxiety, and anticipation to depression; (3) Tolerance of uncertainty moderated the path coefficient of worry to anxiety; (4) Social support moderated the path coefficient of anticipation to anxiety. In conclusion, during quarantine, dispositional optimism, uncertainty tolerance, and social support can buffer the direct or indirect effects of quarantine length on depression and anxiety. These findings could have profound implications on the societal responses to COVID-19 and future pandemics.

Keywords: COVID-19, quarantine, depression, anxiety, worry, anticipation, protective factor

INTRODUCTION

Due to the high infectivity of the novel coronavirus disease (COVID-19), Wuhan was locked down on January 23, 2020 to curb the further deterioration and spread of COVID-19. On January 30, 2020, the World Health Organization (WHO) declared the outbreak of COVID-19 as an international public health emergency. On March 11, 2020,

the WHO further declared COVID-19 as a pandemic largely due to the uprising COVID-19 cases in Europe, especially Italy, and the United States. As of today (mid-May), confirmed cases in the United States reached 1.5 million.

As the first country to fight the COVID-19 epidemic, China has accumulated valuable experience in detection, clinical diagnosis and treatment, epidemiological statistics, and transmission control. The sharp decrease in the number of confirmed cases within two months in China after the Wuhan lockdown has demonstrated that self-quarantine/isolation¹ play a role in controlling the spread of COVID-19. However, self-quarantine with extended duration can have various negative impacts on mental health in the individuals in isolation. Some recent studies have documented depression and anxiety of different degrees at various age groups (Cao et al., 2020; Wang et al., 2020a) that can stay for at least 4 weeks (Wang et al., 2020b) during the COVID-19 epidemic in China.

However, little empirical research has assessed the potential mediating processes on the effects of quarantine on depression and anxiety, even though this knowledge could be important for the general public to cope with the potential mental health issues from extended isolation. The present study was thus carried out about 20 days after the lockdown of Wuhan, the epicenter of the coronavirus outbreak in China. At that time, as the number of confirmed cases in China was still rising, many cities across the country were in self quarantine at home. We assessed various individual difference factors, including worry, anticipation, dispositional optimism, tolerance of uncertainty, social support, and healthy behaviors, for the relationship between quarantine length and negative affect.

According to Schulz and Lazarus (2012), various cognitive factors mediate the relationship between stimulus and emotion, and the resulting emotional experience (e.g., how people interpret or evaluate the emotional stimulus). One of the cognitive factors is worry, the thinking of a problem and the cognitive tendency that cannot be relieved (Mennin et al., 2004). Worry often shows a unique relationship with generalized anxiety disorder and is also common in a variety of mental disorders, including depression (Mohlman et al., 2004; Gladstone et al., 2005). Specifically, cancer patients' worry about losing life can affect their depression (Rao et al., 2017). Therefore, we hypothesized that the anticipation of infection and worry would mediate the relationship between quarantine length and depression and anxiety.

The extent to which the individuals are more less affected by quarantine and negative cognition (including worry and anticipation) may be closely related to the inner resources such as dispositional optimism. Dispositional optimism is defined as the belief that future events may have positive results (Lai and Yue, 2000; Jiang et al., 2016). It can provide psychological capital

to support individual's growth and development with positive psychological state. Dispositional optimism, as an important predictor of subjective well-being (Scheier and Carver, 1992), is often associated with less pain in difficult times (Taylor et al., 1990). It is thus expected that individuals with high levels of dispositional optimism will show less stress, depression, and loneliness, but receive more social support, than those with low levels of dispositional optimism (Taylor et al., 1990). Dispositional optimism can further promote mental and physical health by buffering the impact of depressing events with positive emotions (Scheier and Carver, 1992). Therefore, we hypothesized that dispositional optimism would moderate the relationship between quarantine length and negative affect and the mediating effect of negative cognitions.

In addition, given the extreme uncertainty regarding the quarantine length and whether the individual will be infected during the COVID-19 epidemic, another important individual factor will be tolerance of uncertainty. It is the set of negative and positive psychological response—cognitive, emotional, and behavioral—provoked by the conscious awareness of the lack knowledge about particular aspects of the world (Hillen et al., 2017). Specifically, individuals who cannot tolerate uncertainty tend to treat ambiguity as a source for stress, frustration, and anxiety, and also to avoid uncertainty as much as possible. For these individuals, various daily events that involve different degrees of uncertainty could trigger negative emotional experiences. Accordingly, individuals with low tolerance of uncertainty tend to show higher levels of depression and anxiety (Dar et al., 2017). We thus hypothesized that tolerance of uncertainty would moderate the relationship between quarantine length and negative affect and the mediating effect of negative cognitions.

According to the buffer model of social support (Thoits, 1982), social support can play an important role for people faced with high-pressure situations by reduce the impact of negative emotions in the following aspects. Firstly, social support can influence people's subjective evaluation of society, which can make individuals feel less stressful in the face of pressure; Secondly, social support can buffer the negative impacts of diseases; Thirdly, social support can help problem solving at difficult times. It is thus expected that social support during quarantine will protect mental health. Accordingly, empirical research has shown that social support can reduce depression and anxiety in cancer patients (Kornblith et al., 2001), predict subsequent depressive symptoms (Khatib et al., 2013), moderated the relationship between stress and depression, anxiety (Raffaelli et al., 2013), and the relationship between acute stress and emotional symptoms (Guo et al., 2020). We thus hypothesized that social support would moderate the relationship between quarantine length and negative affect and the mediating effect of negative cognitions.

As for the last factor, there is a large literature demonstrating the effects of healthy behaviors on mental health. For instance, exercise and healthy diet can reduce depression and anxiety (Byrne and Byrne, 1993; Saneei et al., 2016; Trudel-Fitzgerald et al., 2016). It is therefore expected that healthy behavior habits during quarantine will improve the emotional state of

¹ According to Centers for Disease Control and Prevention (<https://www.cdc.gov/quarantine/>), quarantine is the separation and restriction of movement of people who have potentially been exposed to a contagion disease to assure if they become unwell, so reducing the risk of them affecting others. The quarantine in this study specifically refers to self-quarantine at home, which was a voluntary practice recommended by the government when the pandemic was started in China.

individuals, and may subsequently break the vicious circle of “quarantine length—negative cognition—negative affect” (i.e., our hypothesis that anticipation and worry about getting infected mediate the relationship between quarantine length and negative affect). Specifically, we hypothesized that healthy behaviors would moderate the relationship between quarantine length and negative affect and the mediating effect of negative cognitions.

In summary, the present study assessed several individual difference factors that may contribute to the effects of quarantine length on depression and anxiety in the general public under self-quarantine during the early phase of COVID-19 epidemic in China. It is expected that (a) quarantine length should predict depression and anxiety; (b) negative cognitive factors (including anticipation and worry) should mediate this relationship between them; (c) dispositional optimism, uncertainty tolerance, social support, and healthy behaviors should further moderate these relationships.

MATERIALS AND METHODS

Participants and Procedures

Potential participants were recruited via online advertisements on social media. Using convenience sampling, 5,115 Chinese residents (72.75% females) were recruited in this online survey study between February 11, and February 19, 2020. The participants were from 32 provinces or autonomous regions including Hong Kong, Macao and Taiwan. Participants' age ranged from 15–71 years [mean = 21.27, standard deviation (*SD*) = 4.40]. In this sample, 0.59% of the participants ($n = 30$) were from Wuhan, 1.00% ($n = 51$) from other key regions designated by Shanghai, and the remaining 98.42% ($n = 5,034$) were from non-key regions². Furthermore, 50.81% of the participants ($n = 2,599$) had family income lower than ¥50,000/year, 31.26% ($n = 1,599$) within ¥50,000/year - ¥100,000/year, 11.18% ($n = 572$) within ¥100,000/year–¥200,000/year, 3.09% ($n = 158$) within ¥200,000/year–¥300,000/year, and 3.66% ($n = 187$) higher than ¥300,000/year. For the level of education, 0.29% ($n = 15$) of the participants graduated from primary school, 0.04% ($n = 2$) from junior high school, 1.23% ($n = 63$) from senior high school, 2.07% ($n = 106$) from junior college, 92.84% ($n = 4,749$) from college, and 3.49% ($n = 180$) postgraduates.

The survey study was conducted online in computer and smartphone friendly format. Participation of the study was anonymous and voluntary. The average completion time was 8.98 min. No monetary compensation was provided to the participants. This study was approved by the body for ethical evaluation of research projects at the Department of

²We adopted the classification launched by the Shanghai Government, China. Key regions refer to the regions with more confirmed cases and were perceived to have a higher level of risk of infection. Non-key regions refer to the regions with no or fewer confirmed cases and were perceived to have a lower level of risk of infection. According to the classification of Shanghai City, 27 cities in China were classified as key regions, whereas all other cities in China were classified as non-key regions. Different home quarantine policies were applied to individuals returning from key vs. non-key regions. For instance, people in the key regions need to be quarantined at for a longer period of time than those who were in the non-key regions (14 vs. 7 days).

Psychology—part of the School for Social and Behavioral Sciences at Nanjing University, China. All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all individual participants included in the study.

Measures

Quarantine Length

The quarantine length was a self-report measure using a single survey question: “how many days have you been quarantined?” The score was as follows: 1 = 0 days, 2 = 1–7 days, 3 = 8–14 days, 4 = more than 15 days.

Depression

We used the depression subscale of Brief Symptom Inventory (Derogatis, 2000) to assess depression symptoms experienced in the past week. The scale comprises 6 items (e.g., “feeling blue” and “feeling hopeless about the future”). Items were rated on a 5-point scale, ranging from 0 (*not at all*) to 4 (*very much*), to indicate the extent to which each statement applied to the participant. The scale produced an acceptable Cronbach's alpha score of 0.84 in the current sample.

Anxiety

We used the anxiety subscale of Brief Symptom Inventory (Derogatis, 2000) to assess anxiety symptoms experienced in the past week. The scale comprises 6 items (e.g., “feeling tense” and “feeling suddenly scared”). Items were rated on a 5-point scale, ranging from 0 (*not at all*) to 4 (*very much*), to indicate the extent to which each statement applied to the participant. The scale had an acceptable Cronbach's alpha score of 0.90.

Worry

We used three items adapted from the McCaul Brief Worry Scale (McCaul and Goetz, n.d.) to assess worry (e.g., how worried are you about the coronavirus?). One item was rated on a 4-point scale, ranging from 1 (*never*) to 4 (*always*), and the other two items were rated on a 5-point scale, ranging from 1 (*not at all*) to 5 (*extremely*), to indicate the extent to which each statement applied to the participant. The scale had an acceptable Cronbach's alpha score of 0.81. The total score across the three items was used as a compound measure for worry.

Anticipation

We used two self-designed items to assess anticipation (i.e., “Do you think that you will contract coronavirus?” and “Do you think that your family will contract coronavirus?”). Items are rated on a 5-point scale, ranging from 1 (*Absolutely not*) to 5 (*Absolutely*), to indicate the extent to which each statement applies to the participant. The scale had an acceptable Cronbach's alpha score of 0.76.

Dispositional Optimism

We used the Life Orientation Test-Revised (Scheier et al., 1994) to assess dispositional optimism. The scale comprises 6 items (e.g., “In uncertain times, I usually expect the best” and “I hardly ever

expect things to go my way”). Items were rated on a 5-point scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), to indicate the extent to which each statement applied to the participant. The scale had an acceptable Cronbach’s alpha score of 0.72.

Tolerance of Uncertainty

We used the Intolerance of Uncertainty–Short Form (Carleton et al., 2007) to assess tolerance of uncertainty. The scale comprises 12 items (e.g., “Unforeseen events upset me greatly” and “It frustrated me not having all the information I need”). Items were rated on a 5-point scale, ranging from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*), to indicate the extent to which each statement applied to the participant. The scale had an acceptable Cronbach’s alpha score of 0.87. We scored all items in reverse, so that the higher the score, the higher the tolerance of uncertainty.

Social Support

We used five items adapted from the Medical Outcomes Study Social Support Survey (Sherbourne and Stewart, 1991) to assess social support (e.g., Does your community often help your family?). Items were rated on a 4-point scale, ranging from 1 (*not at all*) to 4 (*extremely*), to indicate the extent to which each statement applied to the participant. The scale had an acceptable Cronbach’s alpha score of 0.74.

Healthy Behavior

We used three self-designed items to assess how many days they engaged in three healthy behaviors over the past week (i.e., engaging in aerobic physical activity for at least 15 min, engaging in strengthening exercises, and eating fruits or vegetables). Items were rated on an 8-point scale, ranging from 1 (0 day) to 8 (7 days), to indicate the extent to which each statement applied to the participant. The scale had an acceptable Cronbach’s alpha score of 0.65.

Data Analysis

The Statistical Package for Social Sciences (SPSS) Version 22.0 and AMOS Version 22.0 were used for data analyses. Firstly, descriptive statistical analysis and statistical analysis of the differences in demographic variables were performed using independent *t*-test for binary factors (i.e., gender and key vs. non-key regions) or ANOVAs for multi-level factors (i.e., family income and education level). For these analyses, some groups with the number of participants fewer than 30 were combined to yield more robust estimates of the group means. For instance, for the current residence, Wuhan and other key regions were combined into one group as the key region. For the education level, we have combined primary school, junior high school, senior high school and junior college as the below-undergraduate group. Secondly, *Pearson* correlation analysis was used to explore the relationships between the main variables. On the basis of these correlation analyses, structural equation model (SEM) was subsequently used to assess the relationships between quarantine length, depression, anxiety, and the mediating effect of anticipation and worry. Finally, in order to investigate the moderated role of dispositional optimism,

tolerance of uncertainty, healthy behavior and social support, SEM multiple-group analysis was carried out with these measures as grouping variables, respectively. In addition, according to the suggestions of Wen et al. (2004), root mean square error of approximation (RMSEA) lower than 0.08, and comparative fit index (CFI), normative fit index (NFI), and Tucker-Lewis index (TLI) higher than 0.90 are used as the cutoff criteria for goodness of fit indices in SEM. It should be noted that, given the large sample size, we define statistical significance for our purposes as effects at $p < 0.01$, as suggested by Sweeny et al. (2020). Furthermore, due to the low reliability of the health behavior scale, we deleted it in the later analysis and only investigated the moderated role of dispositional optimism, tolerance of uncertainty, and social support.

RESULTS

Preliminary Analysis

The results of the descriptive statistic of each demographic variable were shown in **Table 1**. The results of independent sample *t*-tests showed that female participants scored significantly higher in anxiety, worry, dispositional optimism, tolerance of uncertainty, and social support than male participants. In addition, quarantine length and score of anxiety, worry, and anticipation were significantly higher in the key regions than those of non-key regions. An ANOVA yielded significant differences in all scales, except for depression, across the level of family annual income. Overall, quarantine length, worry, and anticipation, and tolerance of uncertainty of individuals with family annual income of more than ¥200,000 were worse than those with a family annual income of <¥200,000. However, this high-income group also showed better experience in dispositional optimism and social support at the same time. In addition, education level had significant effects on all scales except tolerance of uncertainty. Specifically, quarantine length, depression, anxiety, worry, anticipation, dispositional optimism, and social support were significantly worse in postgraduates than those of the other two groups.

Correlation Analysis

As shown in **Table 2**, correlation coefficients among all variables were significant expect for the relationship between quarantine length and social support, between worry and social support, and between tolerance of uncertainty and social support.

Testing the Mediation Role of Worry and Anticipation

According to the results of the correlation analyses, quarantine length, worry, anticipation, depression, and anxiety were related to each other, which meets the requirements of the multiple mediation model (Marsh et al., 2004). SEM was thus used to further explore the mediation role of worry and anticipation with quarantine length as the independent variable and

TABLE 1 | Descriptive statistics of and difference in demographic variables of all study variables ($M \pm SD$).

	QL	Depression	Anxiety	Worry	Anticipation	DO	TU	SS
Total	1.69 ± 1.20	3.42 ± 3.67	3.57 ± 4.02	6.78 ± 1.92	3.25 ± 1.42	22.77 ± 3.94	45.33 ± 7.97	13.23 ± 3.15
Gender								
Male	1.68 ± 1.18	3.44 ± 3.88	3.32 ± 4.18	6.45 ± 2.13	3.18 ± 1.45	21.92 ± 4.13	43.72 ± 8.57	12.75 ± 3.41
Female	1.69 ± 1.20	3.41 ± 3.59	3.66 ± 3.95	6.90 ± 1.82	3.27 ± 1.41	23.09 ± 3.82	45.93 ± 7.65	13.41 ± 3.02
<i>t</i>	-0.43	0.26	-2.65**	-6.91***	-2.02	-9.20***	-8.45***	-6.35***
<i>Cohen's d</i>	—	—	-0.08	-0.23	—	-0.29	-0.27	-0.20
Current residence								
Key regions	2.60 ± 1.46	4.21 ± 3.88	5.27 ± 4.94	7.59 ± 1.96	4.17 ± 1.63	22.01 ± 3.79	45.73 ± 7.51	13.22 ± 3.34
Non-key regions	1.68 ± 1.19	3.41 ± 3.66	3.54 ± 3.99	6.76 ± 1.92	3.23 ± 1.41	22.79 ± 3.94	45.32 ± 7.98	13.23 ± 3.14
<i>t</i>	5.69***	1.95	3.14**	3.85***	5.92***	-1.82	0.45	-0.03
<i>Cohen's d</i>	0.69	—	0.39	0.43	0.62	—	—	—
Family income								
<¥50,000 (1)	1.62 ± 1.16	3.36 ± 3.63	3.50 ± 3.91	6.68 ± 1.89	3.16 ± 1.37	22.54 ± 3.97	45.59 ± 8.03	12.91 ± 3.19
¥50,000– ¥100,000 (2)	1.67 ± 1.18	3.38 ± 3.50	3.41 ± 3.80	6.79 ± 1.83	3.25 ± 1.40	23.20 ± 3.77	45.42 ± 7.61	13.51 ± 2.99
¥100,000– ¥200,000 (3)	1.83 ± 1.26	3.62 ± 3.86	3.91 ± 4.47	6.98 ± 2.03	3.38 ± 1.48	22.49 ± 4.04	43.91 ± 8.10	13.63 ± 3.17
¥200,000– ¥300,000 (4)	2.09 ± 1.37	3.68 ± 4.06	4.23 ± 4.38	7.31 ± 1.98	3.85 ± 1.64	22.96 ± 4.11	45.12 ± 8.37	13.87 ± 3.10
>¥300,000 (5)	1.99 ± 1.32	3.7 ± 4.51	4.26 ± 5.10	6.90 ± 2.53	3.64 ± 1.74	23.07 ± 4.22	45.43 ± 9.04	13.63 ± 3.37
<i>F</i>	11.65***	1.23	4.28**	6.38***	14.73***	7.93***	5.31***	14.75***
η_p^2	0.01	—	0.003	0.01	0.01	0.01	0.004	0.01
<i>Post-hoc tests</i> (Bonferroni)	3 > 1; 4 > 1; 5 > 1; 4 > 2; 5 > 2	—	Ns	3 > 1; 4 > 1; 4 > 2;	3 > 1; 4 > 1; 4 > 2; 4 > 3; 5 > 1; 5 > 2	2 > 1; 2 > 3	1 > 3; 2 > 3	2 > 1; 3 > 1; 4 > 1; 5 > 1
Education level								
Below college degree (1)	1.76 ± 1.21	4.00 ± 4.21	4.26 ± 4.64	6.48 ± 2.10	3.37 ± 1.49	22.25 ± 4.18	44.84 ± 8.60	12.62 ± 3.25
Undergraduate (2)	1.67 ± 1.18	3.34 ± 3.58	3.44 ± 3.87	6.76 ± 1.89	3.20 ± 1.39	22.83 ± 3.93	45.34 ± 7.94	13.27 ± 3.15
postgraduate (3)	2.25 ± 1.41	4.79 ± 4.83	6.24 ± 5.70	7.52 ± 2.31	4.36 ± 1.61	21.80 ± 3.91	45.66 ± 8.04	12.63 ± 2.93
<i>F</i>	21.18***	15.99***	45.78***	15.73***	59.77***	7.62***	0.50	7.33**
η_p^2	0.01	0.01	0.02	0.01	0.02	0.003	—	0.003
<i>Post-hoc tests</i> (Bonferroni)	3 > 1; 3 > 2	3 > 2	1 > 2; 3 > 1; 3 > 2	3 > 1; 3 > 2	3 > 1; 3 > 2	2 > 3	—	2 > 3

*** $p < 0.001$, ** $p < 0.01$.

QL, quarantine length; DO, dispositional optimism; TU, tolerance of uncertainty; SS, social support. The following are the same.

depression and anxiety as the dependent variable. It should be noted that:

- As all variables are on single-dimension scales, they were treated as latent variables and their items were treated as explicit variables to better fit models.
- Given the significant correlation between worry and anticipation, the correlation between worry and anticipation was established in order to avoid Type I error in expanding the model calculation results. More importantly, considering the often cooccurring and correlated depression and anxiety, we also established a correlation between depression and anxiety.
- Because of the significant differences in several measures across gender, current residence, family income, and education level, these variables with significant differences were used as covariates to test the model among quarantine

length, worry, anticipation, depression, and anxiety. However, for the sake of visual presentation of the results, they were not shown in the figures presented in this paper.

The SEM produced reasonable fits of the data ($\chi^2/df = 5.19$, RMSEA = 0.03, IFI = 0.98, CFI = 0.98, TLI = 0.98). As shown in **Figure 1**, further analyses of the paths in the model yielded significant predictive effects of quarantine length on depression ($\beta = 0.09$, $t = 6.09$, $p < 0.001$), anxiety ($\beta = 0.04$, $t = 3.09$, $p = 0.002$), worry ($\beta = 0.13$, $t = 8.79$, $p < 0.001$) and anticipation ($\beta = 0.13$, $t = 8.30$, $p < 0.001$), significant predictive effects of worry on depression ($\beta = 0.20$, $t = 11.58$, $p < 0.001$) and anxiety ($\beta = 0.29$, $t = 17.89$, $p < 0.001$), and significant predictive effects of anticipation on depression ($\beta = 0.24$, $t = 13.44$, $p < 0.001$) and anxiety ($\beta = 0.22$, $t = 13.57$, $p < 0.001$). These results show that worry and anticipation contribute in a mediating role between quarantine length and depression. The mediating effect value

TABLE 2 | Intercorrelations between all study measures.

Variables	1	2	3	4	5	6	7	8
1. QL	1							
2. Depression	0.14***	1						
3. Anxiety	0.12***	0.73***	1					
4. Worry	0.13***	0.25***	0.35***	1				
5. Anticipation	0.13***	0.26***	0.29***	0.26***	1			
6. DO	-0.07***	-0.36***	-0.29***	-0.09***	-0.23***	1		
7. TU	-0.08***	-0.31***	-0.31***	-0.24***	-0.14***	0.29***	1	
8. SS	0.02	-0.20***	-0.14***	0.03	-0.07***	0.38***	0.03	1

*** $p < 0.001$, ** $p < 0.01$.

was 0.06, accounting for 40.00% of the total effect³. Worry and anticipation also play a mediating role between quarantine length and anxiety. The mediating effect value was 0.07, accounting for 63.64% of the total effect.

Testing the Moderated Role of Dispositional Optimism, Tolerance of Uncertainty, and Social Support

In order to investigate the moderated role of dispositional optimism, tolerance of uncertainty, and social support, SEM multiple-group analysis was carried out with these measures as grouping variables, respectively. Specifically, using the ± 1 SD as the grouping standard, the high and low group were selected to fit the model in **Figure 1**, to analyze whether the model has significant effects across different levels of dispositional optimism, tolerance of uncertainty, and social support. According to the requirements of multiple-group comparison of models (Wen et al., 2003), the following three nested models were defined:

Model 1 (unconstrained model): The same model structure was defined for different groups, without any restrictions on each parameter in the model;

Model 2 (measurement model): Based on Model 1, the path coefficients of different groups of measurement models were limited to be equal;

Model 3 (structural model): Based on Model 2, the path coefficients of different groups of structural model parts were limited to be equal.

If there was a significant difference between the two groups in some path coefficients, a simple slope test (Preacher et al., 2006) was conducted to further test the moderated effect of each moderated variable on the significant paths.

The Moderated Effect of Dispositional Optimism

The results showed that the model fit indices for Model 1, Model 2, and Model 3 were good (see **Table 3**). Further analyses showed

significant differences between the high and low *Dispositional Optimism* groups in the measurement ($\Delta\chi^2/\Delta df = 19.51$, $p < 0.001$) and structural models ($\Delta\chi^2/\Delta df = 14.63$, $p < 0.001$). The difference between the measurement structural model was also significant ($\Delta\chi^2/\Delta df = 6.70$, $p < 0.001$). The results of pairwise parameter comparisons showed that the path coefficients of quarantine length to worry (see **Figure 2A1** and **Table 4**), worry to anxiety (see **Figure 2A2** and **Table 4**), and anticipation to depression (see **Figure 2A3** and **Table 4**) were significantly different between the two groups ($p < 0.01$).

The Moderated Effect of Tolerance of Uncertainty

The results showed that the model fit indices of Model 1, Model 2, and Model 3 were good (see **Table 3**). Further analyses showed significant differences between the high and low *Tolerance of Uncertainty* groups in the measurement ($\Delta\chi^2/\Delta df = 4.95$, $p < 0.001$) and structural models ($\Delta\chi^2/\Delta df = 4.28$, $p < 0.001$). The difference between the measurement and structural model was also significant ($\Delta\chi^2/\Delta df = 3.18$, $p < 0.001$). The results of pairwise parameter comparison showed that the path coefficients of worry to anxiety (see **Figure 2B**; **Table 4**) was significantly different between the two groups ($p < 0.01$).

The Moderated Effect of Social Support

The results showed that the model fit indices of Model 1, Model 2, and Model 3 were good (see **Table 3**). Further analyses showed that there were significant differences between the high and low *Social Support* groups in the measurement ($\Delta\chi^2/\Delta df = 5.39$, $p < 0.001$) and structural models ($\Delta\chi^2/\Delta df = 4.21$, $p < 0.001$). The difference between the measurement and structural model was also significant ($\Delta\chi^2/\Delta df = 2.29$, $p = 0.02$). The results of pairwise parameter comparison showed that the path coefficients of anticipation to anxiety (see **Figure 2C** and **Table 4**) was significantly different between the two groups ($p < 0.01$).

DISCUSSION

In this study, SEM was used to investigate the relationship between quarantine length and negative affect, as well as the roles of negative cognitions and several protective factors. The results showed that anticipation and worry partially mediated the relationship between quarantine length and negative affect.

³The mediating effect value was calculated by the sum of the path coefficient from the independent variable to the mediated variable multiplied by the path coefficient from the mediated variable to the dependent variable. And the proportion of the mediating effect was calculated by the sum of the mediating effect divided by the mediating effect plus the direct effect.

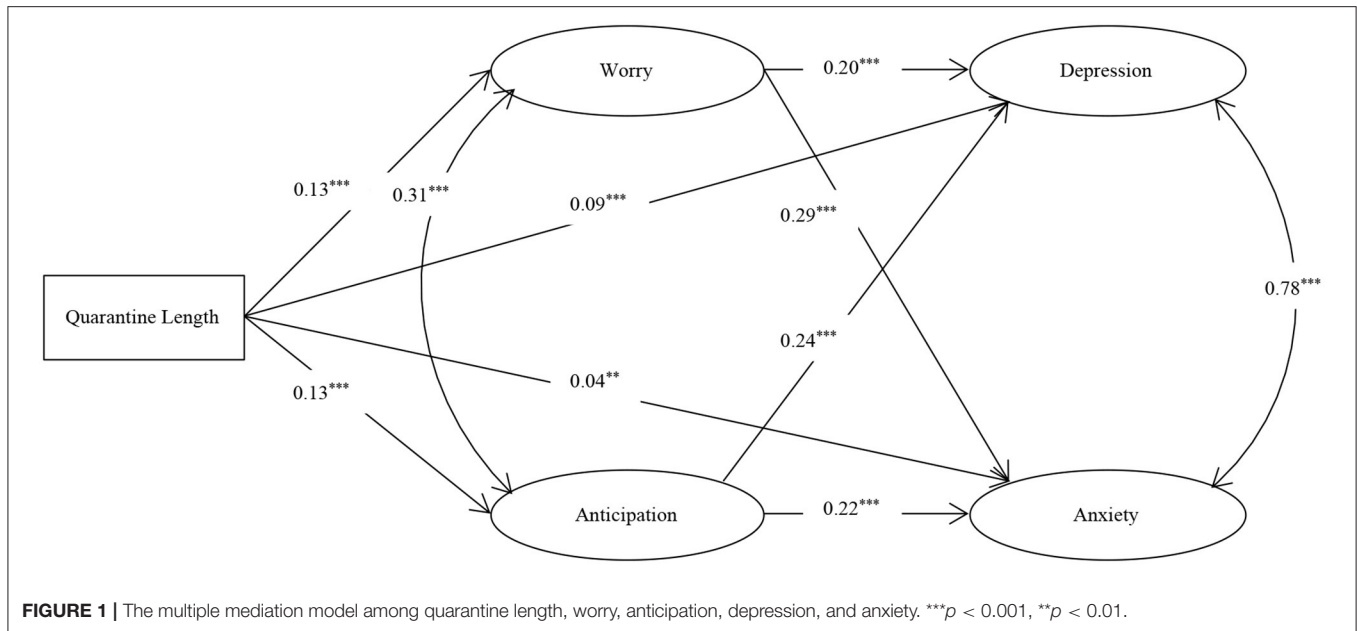


TABLE 3 | Models' fit indices.

Model	χ^2	df	χ^2/df	CFI	NFI	TLI	RMSEA
Moderated variable: dispositional optimism							
Model 1	706.10	338	2.09	0.98	0.96	0.97	0.02
Model 2	959.69	351	2.73	0.96	0.94	0.95	0.03
Model 3	1013.27	359	2.82	0.96	0.94	0.95	0.03
Moderated variable: tolerance of uncertainty							
Model 1	632.92	338	1.87	0.98	0.95	0.97	0.02
Model 2	697.29	351	1.99	0.97	0.95	0.97	0.03
Model 3	722.73	359	2.01	0.97	0.95	0.96	0.03
Moderated variable: social support							
Model 1	788.156	338	2.33	0.98	0.96	0.97	0.03
Model 2	858.25	351	2.45	0.97	0.95	0.96	0.03
Model 3	876.59	359	2.44	0.97	0.5	0.96	0.03

Dispositional optimism, tolerance of uncertainty, and social support moderated one or more paths of the relationship among quarantine length, anticipation, worry, depression, and anxiety. High dispositional optimism, high tolerance of uncertainty, and good social support can decrease the prediction effects of some paths.

Demographic Factors

Consistent with longer quarantine in the key regions, anxiety, worry, and anticipation of infection were higher in residents from the key regions than those in residents from non-key areas. Interestingly, women experienced worse anxiety, and worry of infection than men did on the one hand, but better dispositional optimism, social support, and tolerance of uncertainty on the other hand, directly replicating a previous finding of increased experience in both negative and positive affect (Yue et al.,

2017). These observations also replicated recent reports of gender differences in emotional disorders during the COVID-19 epidemic (Wang et al., 2020a,b). They are also consistent with the overall findings of higher rate of depression and anxiety in women (Altemus, 2006; Altemus et al., 2014) and higher rate of posttraumatic stress disorder (PTSD) after traumatic events in women (Breslau, 2009; Luxton et al., 2010). The gender differences in social support, dispositional optimism, and tolerance of uncertainty may result from women's better ability to utilize social support for psychological well-being (Flaherty and Richman, 1989) and to perceive happiness in daily life (Bradburn, 1969). It is worth noting that, although most of our samples are well-educated females, which was similar to the previous studies (Li et al., 2020; Ustun, 2020), it is still possible that the contradictory findings that women reported higher levels of anxiety and worry as well as optimism and social support may

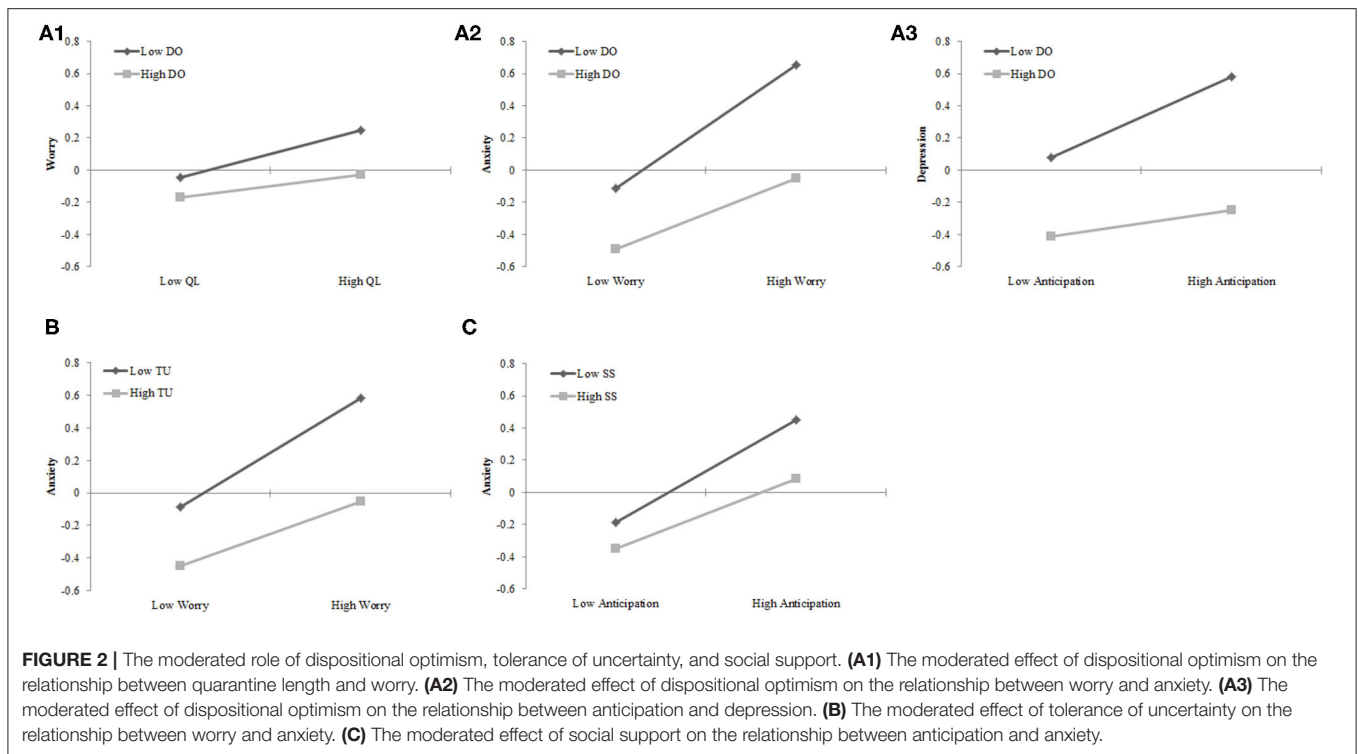


TABLE 4 | Simple slope test results.

Path	Moderated variable: DO				Moderated variable: TU				Moderated variable: SS			
	Low group (n = 914)		High group (n = 938)		Low group (n = 837)		High group (n = 705)		Low group (n = 1,065)		High group (n = 836)	
	β	t	β	t	β	t	β	t	β	t	β	t
QL → Worry	0.15	7.72***	0.07	3.64***	—	—	—	—	—	—	—	—
QL → Anticipation	—	—	—	—	—	—	—	—	—	—	—	—
Worry → Depression	—	—	—	—	—	—	—	—	—	—	—	—
Worry → Anxiety	0.38	23.44***	0.22	12.40***	0.33	20.44***	0.21	10.89***	—	—	—	—
Anticipation → Depression	0.25	15.06***	0.09	4.25***	—	—	—	—	—	—	—	—
Anticipation → Anxiety	—	—	—	—	—	—	—	—	0.32	17.57***	0.22	11.01***
QL → Depression	—	—	—	—	—	—	—	—	—	—	—	—
QL → Anxiety	—	—	—	—	—	—	—	—	—	—	—	—

Low group means those whose scores lower than $M - 1$ SD, while high group means those whose scores higher than $M + 1$ SD. *** $p < 0.001$, ** $p < 0.01$.

partially reflect a tendency to respond in an acquiescent manner in the collectivist culture, as suggested in Rammstedt et al. (2017). Therefore, caution is still advised before drawing conclusions.

Another demographic factor, family annual income, also had similar impacts on most measures. Specifically, worry, anticipation, and tolerance of uncertainty of individuals with family annual income of more than ¥200,000 were worse than those with a family annual income of <¥200,000. However, this high-income group also showed better experience in dispositional optimism and social support at the same time. These seemingly contradictory findings may result from the association between the level of annual family income and

the source of the family income. On the one hand, some industries have high income but low stability (e.g., self-employed households), while others have low to medium income but high stability (e.g., civil servants). It is possible that individuals with annual household income higher than ¥200,000 had less stability in maintaining their income. Consequently, worry, anticipation and intolerance of uncertainty of individuals were in these participants, which is consistent with a recent finding that the level of mental health of individuals with unstable family income was low in the epidemic (Cao et al., 2020). On the other hand, these participants with higher family income may expect speedy recovery of their

income in the near future, which subsequently leads to higher dispositional optimism.

It is worth noting that quarantine length, depression, anxiety, worry, anticipation, dispositional optimism and social support were worse in postgraduates than participants with junior college degree or below. The worse emotional well-being in postgraduates in the present study is consistent with the overall findings of the potential mental health issues in postgraduates (e.g., Hou et al., 2013). For instance, Evans et al. (2018) conducted a comprehensive survey of 2,279 people through social media and e-mail and found that postgraduates were six times more likely to suffer from depression than the general population. Cao et al. (2020)'s study indicated that delays in academic activities was positively associated with college students' anxiety symptom. As far as we know, this phenomenon may be more obvious in postgraduate students because the epidemic makes them unable to return to school and lab to continue their research work, most of which can't be solved online like learning work. These delays in academic activities will lead to their delay in graduation, and further affect their future availability of jobs and incomes.

Quarantine Length and Negative Affect

One of the key finding of the present study is that quarantine length, anticipation, worry, depression, and anxiety are correlated with each other. Removal of the social environment during the quarantine can be an important source of psychological stress. In the literature, lots of research on quarantine are based on analog simulation of space environment. For example, participants in bed rest for 60 days exhibited fluctuations (high-low-high-low) in depression and anxiety over time (Qin et al., 2010). Similarly, high prevalence of psychological distress was also reported in quarantined respondents to a web-based survey during the onset of SARS (Hawryluck et al., 2004). Specifically, symptoms of PTSD and depression were reported in 28.9 and 31.2% of the respondents in this study, respectively. In addition, longer durations of quarantine were associated with increased prevalence of PTSD symptoms. Consistent with previous these previous findings, our study also found the predictive effect of quarantine length on negative affect.

The Mediating Roles of Worry and Anticipation

On the basis of correlation analysis, we further use SEM to investigate the mediating effect of anticipation and worry on quarantine length and negative affect. Consistent with the hypothesis, worry and anticipation about the COVID-19 mediate the relationship between quarantine length and negative affect. Specifically, the longer the durations of quarantine are, the greater anticipation and worry of individuals and their families to contract the virus are, which further worsens depression and anxiety symptoms. This result is in line with Schulz and Lazarus (2012)'s cognitive mediation theory and also a previous finding that negative cognition such as worry can mediate the relationship between stress events and depression (Young and Dietrich, 2015). Together these findings suggest that quarantine, as an acute stress event, can activate people's negative cognitive sensitivity, and consequently aggravating depression and anxiety.

The Moderated Roles of Protective Factors

The results of multiple-group analyses highlighted three factors. First, dispositional optimism moderated the path coefficients of quarantine length to worry, worry to anxiety, and anticipation to depression. These novel findings are consistent with some previous evidence that dispositional optimism can act as a buffer. For instance, dispositional optimism can alleviate the relationship between stress and mental health (Chang, 1998), negative life events and suicide intention (Hirsch et al., 2007). This is because, as a protective factor, dispositional optimism can promote positive and future-oriented evaluations of external events and their negative physiological and psychological consequences (Brissette et al., 2002). Individuals with high level of dispositional optimism may be more positive in considering negative and potentially traumatic living environment than those with low level of dispositional optimism (Miller et al., 1996). Therefore, in the context of quarantine during the epidemic, individuals with higher dispositional optimism may prioritize the positive effects of lockdown measures such as the public health benefits over its negative impacts and adjust their lifestyle in a timely manner. That is, dispositional optimism provides a protective mental mechanism to buffer the effects of worry and anticipation on mental health (e.g., limit the growth of anticipation and worry over the quarantine period).

Second, tolerance of uncertainty moderated the path coefficient of worry to anxiety. Tolerance of uncertainty has recently gained research interests in the health care context, given the various sources of uncertainties in clinical setting (Hillen et al., 2017), including whether a patient has or will develop a particular condition; how that condition will evolve; to what extent a particular treatment is beneficial; and whether a patient is receiving the right care, in the right place, at the right time, and from the right people. Similarly, in the context of the epidemic, people who are quarantined face many uncertainties: when can the epidemic be effectively controlled; whether I or my family will be infected by the virus; how to maintain steady income to support family. Consequently, individuals with higher tolerance of uncertainty will experience less negative affect for a given level of worry.

Third, social support moderated the path coefficient of anticipation to anxiety. At present, the relationship between social support and physical and mental health has reached a general consensus, but the mechanisms of social support are still controversial (Cohen and Wills, 1985). On the one hand the main effect model states that high social support is often accompanied by better mental health; on the other hand, the buffer model asserts that social support only plays a significant role in high stress situations such that it will protect individuals from the adverse effects of stress (Cohen and Wills, 1985). The results of correlation analyses in this study showed that social support was negatively correlated with depression, anxiety, and anticipation, supporting the main effect model of social support. Results of multiple-group analysis, in line with previous findings (Khatib et al., 2013; Raffaelli et al., 2013), showed that social support moderated the path coefficient of anticipation to anxiety, supporting the buffer model of social support. These findings

suggest that in the context of the epidemic, social support (including emotional comfort and practical help) from relatives, friends, and the community can effectively reduce negative affect.

Implications and Limitations

This study examined the effects of quarantine length on negative affect during COVID-19 and the potential mediating and moderating factors. The moderating effects have identified dispositional optimism, uncertainty tolerance, and social support as potential psychological buffers for coping with the negative affect experienced during COVID-19. These protective factors are supplementary to those reported in a recent study (Wang et al., 2020b) that highlighted beneficial contributions of high level of confidence in doctors, perceived survival likelihood and low risk of contracting COVID-19, satisfaction with health information, and personal precautionary measures. These findings are highly informative for the society to develop strategies for mitigating public health crises such as the COVID-19 pandemic. In addition, our findings highlight potentially important practices, including dispositional optimism, uncertainty tolerance, and social support that the individuals could adopt to better cope with the pandemic in other impacted countries.

Nonetheless, this study has some caveats. Firstly, with a cross-sectional design (i.e., quarantine length is measured across respondents) and the regression approach, the present findings do not provide any evidence for a causal relationship between quarantine length and negative affect. Second, with the development of epidemic situation over time, the observed relationships among the various factors and measures may be dynamic and different at different key timepoints. As a result, it is unclear whether our current findings can be generalized from the study period (20 days after the outbreak) to other time points of this epidemic. Thirdly, to facilitate participant recruitment and to ensure the data quality for this online survey study at a particularly stressful time, we tried to limit the study length to roughly 10 min. Consequently, most measures in the present study used short scales instead of the complete scales. Although these short scales have been well-established in the literature, future research needs to implement the full scales to get a more systematical assessment of the various outcome measures. Fourthly, the short quarantine and measurement of quarantine length as Likert-5 scale rather than accurate days limits the statistical power, which affected the effect sizes, especially the relationship involving quarantine length. Therefore, caution is still advised before drawing conclusions. Fifthly, the method of multiple-group analysis in moderated effect tests leads to waste of participants, so the results of the moderated variable as continuous variables as shown in the Supplements can also be considered. Sixthly, due to the number of non-key regions was significantly larger than the number of key regions (27 vs. 636 cities), 1.59% of participants were from the key regions, whereas approximately 98.41% of participants were from the non-key regions in this study, so the present findings may mainly reflect the epidemic related mental health issues in these non-key regions. Seventhly, the method of convenient sampling limits the

generalization of our conclusion. On the one hand, according to study demographics, the samples essentially represent Chinese female college students, as indicated by gender ratio (72.75% females) and average age (21.27 ± 4.40); on the other hand, based on the significant negative correlations between completion time and quarantine length ($r = -0.04, p = 0.004$) and depression ($r = -0.06, p < 0.001$), and significant positive correlations between completion time and dispositional optimism ($r = -0.21, p < 0.001$), tolerance of uncertainty ($r = -0.13, p < 0.001$), and social support ($r = -0.06, p < 0.001$), survey completers represent the subset of the distribution most interested in survey content although these effect sizes are relatively low. Take these two aspects together, these should be very cautious when conclusions are generalized to other populations. Eighthly, we focused on the situation of voluntary quarantine at home in the current study, future research should further examine the negative affect in forced quarantine and the differences between forced quarantine and voluntary quarantine. Finally, although the similar increased levels of depression and anxiety during epidemics have been demonstrated in many countries (e.g., US; Ettman et al., 2020), and the worry about COVID-19 infection in Japan was similar to the results of this study (Sasaki et al., 2020), it is still necessary to conduct further cross-cultural studies to compare these variables (e.g., intensity, frequency, and interpretation of worry) and their relationship in the future.

CONCLUSION

This study found that quarantine length could predict depression and anxiety. This relationship is further mediated by worry and anticipation about the COVID-19, and moderated by several protective factors, including dispositional optimism, uncertainty tolerance, and social support.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the body for ethical evaluation of research projects at the Department of Psychology—part of the School for Social and Behavioral Sciences at Nanjing University, China. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LH, FL, and YM collected the data. LH and RZ analyzed and interpreted the data. LH, XC, and WZ wrote the current version of the manuscript. All authors have made a significant contribution to this work.

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REFERENCES

- Altemus, M. (2006). Sex differences in depression and anxiety disorders: Potential biological determinants. *Horm. Behav.* 50, 534–538. doi: 10.1016/j.yhbeh.2006.06.031
- Altemus, M., Sarvaiya, N., and Epperson, C. N. (2014). Sex differences in anxiety and depression clinical perspectives. *Front. Neuroendocrinol.* 35, 320–330. doi: 10.1016/j.yfrne.2014.05.004
- Bradburn, N. M. (1969). *The Structure of Psychological Well-Being*. Chicago, IL: Aldine. doi: 10.1037/t10756-000
- Breslau, N. (2009). The epidemiology of trauma, PTSD, and other posttrauma disorders. *Trauma Violence Abuse* 10, 198–210. doi: 10.1177/1524838009334448
- Brissette, I., Scheier, M. F., and Carver, C. S. (2002). The role of optimism in social network development, coping, and psychological adjustment during a life transition. *J. Pers. Soc. Psychol.* 82:102. doi: 10.1037/0022-3514.82.1.102
- Byrne, A., and Byrne, D. G. (1993). The effect of exercise on depression, anxiety and other mood states: a review. *J. Psychosom. Res.* 37, 565–574. doi: 10.1016/0022-3999(93)90050-P
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287:112934. doi: 10.1016/j.psychres.2020.112934
- Carleton, R. N., Norton, M. P. J., and Asmundson, G. J. (2007). Fearing the unknown: a short version of the intolerance of uncertainty scale. *J. Anxiety Disord.* 21, 105–117. doi: 10.1016/j.janxdis.2006.03.014
- Chang, E. C. (1998). Does dispositional optimism moderate the relation between perceived stress and psychological well-being?: a preliminary investigation. *Pers. Individ. Diff.* 25, 233–240. doi: 10.1016/S0191-8869(98)00028-2
- Cohen, S., and Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychol. Bull.* 98:310. doi: 10.1037/0033-2909.98.2.310
- Dar, K. A., Iqbal, N., and Mushtaq, A. (2017). Intolerance of uncertainty, depression, and anxiety: examining the indirect and moderating effects of worry. *Asian J. Psychiatry* 29, 129–133. doi: 10.1016/j.ajp.2017.04.017
- Derogatis, L. R. (2000). *The Brief Symptom Inventory-18 (BSI-18): Administration, Scoring, and Procedures Manual, 3rd Edn*. Minneapolis, MN: National Computer Systems. doi: 10.1037/t07502-000
- Ettman, C. K., Abdalla, S. M., Cohen, G. H., Sampson, L., Vivier, P. M., and Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw. Open* 3, e2019686–e2019686. doi: 10.1001/jamanetworkopen.2020.19686
- Evans, T., Bira, L., Gastelum, J., Weiss, L., and Vanderford, N. (2018). Evidence for a mental health crisis in graduate education. *Nat. Biotechnol.* 36, 282–284. doi: 10.1038/nbt.4089
- Flaherty, J., and Richman, J. (1989). Gender differences in the perception and utilization of social support: theoretical perspectives and an empirical test. *Soc. Sci. Med.* 28, 1221–1228. doi: 10.1016/0277-9536(89)90340-7
- Gladstone, G. L., Parker, G. B., Mitchell, P. B., Malhi, G. S., Wilhelm, K. A., and Austin, M. P. (2005). A brief measure of worry severity (BMWS): personality and clinical correlates of severe worriers. *J. Anxiety Disord.* 19, 877–892. doi: 10.1016/j.janxdis.2004.11.003
- Guo, L., Xu, P. R., Yao, F., Zhang, F. Y., Qi, L., and Yang, F. H. (2020). The influence of public acute stress disorder on negative emotions in China under major epidemic – The moderate effect of social support. *J. Southwest Univ.* 42, 21–30. doi: 10.13718/j.cnki.xdzk.2020.05.003
- Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., and Styr, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emerg. Infect. Dis.* 10, 1206–1212. doi: 10.3201/eid1007.030703
- Hillen, M. A., Gutheil, C. M., Strout, T. D., Smets, E. M., and Han, P. K. (2017). Tolerance of uncertainty: conceptual analysis, integrative model, and implications for healthcare. *Soc. Sci. Med.* 180, 62–75. doi: 10.1016/j.socscimed.2017.03.024
- Hirsch, J. K., Wolford, K., LaLonde, S. M., Brunk, L., and Morris, A. P. (2007). Dispositional optimism as a moderator of the relationship between negative life events and suicide ideation and attempts. *Cogn. Ther. Res.* 31, 533–546. doi: 10.1007/s10608-007-9151-0
- Hou, R. H., Wen, S. F., Yu, G. L., and Fan, Z. F. (2013). Investigation on postgraduates' subjective well-being, depression and anxiety. *CMHJ.* 27, 479–480. doi: 10.3969/j.issn.1000-6729.2013.06.015
- Jiang, F., Yue, X., Lu, S., Yu, G., and Zhu, F. (2016). How belief in a just world benefits mental health: the effects of optimism and gratitude. *Soc. Indic. Res.* 126, 411–423. doi: 10.1007/s11205-015-0877-x
- Khatib, Y., Bhui, K., and Stansfeld, S. A. (2013). Does social support protect against depression and psychological distress? Findings from the RELACHS study of East London adolescents. *J. Adolesc.* 36, 393–402. doi: 10.1016/j.adolescence.2013.01.001
- Kornblith, A. B., Herndon II, J. E., Zuckerman, E., Viscoli, C. M., Horwitz, R. I., Cooper, M. R., et al. (2001). Social support as a buffer to the psychological impact of stressful life events in women with breast cancer. *Cancer* 91, 443–454. doi: 10.1002/1097-0142(20010115)91:2<443::aid-cnrcr1020>3.0.co;2-z
- Lai, J. C., and Yue, X. (2000). Measuring optimism in Hong Kong and mainland Chinese with the revised life orientation test. *Pers. Individ. Diff.* 28, 781–796. doi: 10.1016/S0191-8869(99)00138-5
- Li, J., Yang, Z., Qiu, H., Wang, Y., Jian, L., Ji, J., et al. (2020). Anxiety and depression among general population in China at the peak of the COVID-19 epidemic. *World Psychiatry* 19:249. doi: 10.1002/wps.20758
- Luxton, D. D., Skopp, N. A., and Maguen, S. (2010). Gender differences in depression and PTSD symptoms following combat exposure. *Depress. Anxiety* 27, 1027–1033. doi: 10.1002/da.20730
- Marsh, H. W., Wen, Z., and Hau, K. T. (2004). Structural equation models of latent interactions: evaluation of alternative estimation strategies and indicator construction. *Psychol. Methods* 9, 275–300. doi: 10.1037/1082-989X.9.3.275
- McCaul, K. D., and Goetz, P. W. (n.d.). Worry. Available online at: <https://cancercontrol.cancer.gov/brp/research/constructs/worry.html> (accessed March 16, 2020).
- Mennin, D. S., Heimberg, R. G., and Turk, C. L. (2004). “Clinical presentation and diagnostic features,” in *Generalized Anxiety Disorder*, eds R. G. Heimberg, C. L. Turk, and D. S. Mennin (New York, NY: Guilford Press), 3–28.
- Miller, D. L., Manne, S. L., Taylor, K., Keates, J., and Dougherty, J. (1996). Psychological distress and well-being in advanced cancer: the effects of optimism and coping. *J. Clin. Psychol. Med. Settings* 3, 115–130. doi: 10.1007/BF01996132
- Mohlman, J., de Jesus, M., Gorenstein, E. E., Kleber, M., Gorman, J. M., Papp, L. A. (2004). Distinguishing generalized anxiety disorder, panic disorder, and mixed anxiety states in older treatment-seeking adults. *J. Anxiety Disord.* 18, 275–290. doi: 10.1016/S0887-6185(02)00261-X
- Preacher, K. J., Curran, P. J., and Bauer, D. J. (2006). Computational tools for probing interactions in multiple linear regression, multilevel

- modeling, and latent curve analysis. *J. Educ. Behav. Stat.* 31, 437–448. doi: 10.3102/10769986031004437
- Qin, H. B., Wang, J., Bai, Y. Q., Wu, B., Liu, X. Y., Jing, X. L., et al. (2010). Effect of 60 d -6° head-down bed rest on the subjects' emotion. *Space Med. Med. Eng.* 23, 163–171. doi: 10.16289/j.cnki.1002-0837.2010.03.005
- Raffaelli, M., Andrade, F. C. D., Wiley, A. R., Sanchez-Armass, O., Edwards, L. L., and Aradillas-Garcia, C. (2013). Stress, social support, and depression: a test of the stress-buffering hypothesis in a Mexican sample. *J. Res. Adolesc.* 23, 283–289. doi: 10.1111/jora.12006
- Rammstedt, B., Danner, D., and Bosnjak, M. (2017). Acquiescence response styles: a multilevel model explaining individual-level and country-level differences. *Pers. Individ. Diff.* 107, 190–194. doi: 10.1016/j.paid.2016.11.038
- Rao, H., Liu, W., Yao, X., Yan, H., Li, S. Y., and Yu, L. P. (2017). Worry about ill consequences in cancer patients and its relationship with depression. *Chongqing Med.* 46, 86–87. doi: 10.3969/j.issn.1671-8348.2017.26.028
- Saneei, P., Hajishafiee, M., Esmailzadeh, A., Hassanzadeh Keshteli, A., Roohafza, H. R., Afshar, H., et al. (2016). *The association between healthy lifestyle with depression and anxiety among adults in Esfahan.*
- Sasaki, N., Kuroda, R., Tsuno, K., and Kawakami, N. (2020). *Fear, Worry and Workplace Harassment Related to the COVID-19 Epidemic Among Employees in Japan: Prevalence and Impact on Mental and Physical Health.* doi: 10.2139/ssrn.3569887
- Scheier, M. F., and Carver, C. S. (1992). Effects of optimism on psychological and physical well-being: theoretical overview and empirical update. *Cogn. Ther. Res.* 16, 201–228. doi: 10.1007/BF01173489
- Scheier, M. F., Carver, C. S., and Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the life orientation test. *J. Pers. Soc. Psychol.* 67:1063. doi: 10.1037/0022-3514.67.6.1063
- Schulz, M. S., and Lazarus, R. S. (2012). "Regulating emotion in adolescence: a cognitive-mediational conceptualization," in *Adolescence and Beyond: Family Processes and Development*, eds P. K. Kerig, M. S. Schulz, and S. T. Hauser (Oxford: Oxford University Press), 19–42. doi: 10.1093/acprof:oso/9780199736546.003.0003
- Sherbourne, C. D., and Stewart, A. L. (1991). The MOS social support survey. *Soc. Sci. Med.* 32, 705–714. doi: 10.1016/0277-9536(91)90150-B
- Sweeny, K., Rankin, K., Cheng, X., Hou, L., Long, F., Meng, Y., et al. (2020). Flow in the time of COVID-19: findings from China. *Plos ONE* 15: e0242043. doi: 10.1371/journal.pone.0242043
- Taylor, S. E., Buunk, B. P., and Aspinwall, L. G. (1990). Social comparison, stress, and coping. *Pers. Soc. Psychol. Bull.* 16, 74–89. doi: 10.1177/0146167290161006
- Thoits, P. A. (1982). Conceptual, methodological, and theoretical problems in studying social support as a buffer against life stress. *J. Health Soc. Behav.* 23, 145–159. doi: 10.2307/2136511
- Trudel-Fitzgerald, C., Tworoger, S. S., Poole, E. M., Williams, D. R., and Kubzansky, L. D. (2016). Prospective changes in healthy lifestyle among midlife women. *Am. J. Prev. Med.* 51, 327–335. doi: 10.1016/j.amepre.2016.04.021
- Ustun, G. (2020). Determining depression and related factors in a society affected by COVID-19 pandemic. *Int. J. Soc. Psychiatry.* doi: 10.1177/0020764020938807
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020a). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17:1729. doi: 10.3390/ijerph17051729
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., et al. (2020b). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behav. Immun.* 87, 40–48. doi: 10.1016/j.bbi.2020.04.028
- Wen, Z. L., Hau, K. T., and Marsh, H. W. (2003). Methods and recent research development in analysis of interaction effects between latent variables. *Adv. Psychol. Sci.* 11, 593–599. Available online at: <http://journal.psych.ac.cn/xlkxjz/CN/Y2003/V11/I05/593>
- Wen, Z. L., Hau, K. T., and Marsh, H. W. (2004). Structural equation model testing: cutoff criteria for goodness of fit indices and Chi-square test. *Acta Psychol. Sin.* 36, 186–194. Available online at: <http://journal.psych.ac.cn/xlxb/CN/Y2004/V36/I02/186>
- Young, C. C., and Dietrich, M. S. (2015). Stressful life events, worry, and rumination predict depressive and anxiety symptoms in young adolescents. *J. Child Adolesc. Psychiatr. Nurs.* 28, 35–42. doi: 10.1111/jcap.12102
- Yue, X. D., Hiranandani, N. A., Jiang, F., Hou, Z., and Chen, X. (2017). Unpacking the gender differences on mental health: the effects of optimism and gratitude. *Psychol. Rep.* 120, 639–649. doi: 10.1177/0033294117701136

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Trust in Science, Perceived Vulnerability to Disease, and Adherence to Pharmacological and Non-pharmacological COVID-19 Recommendations

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Protection motivation theory (PMT) is a theoretical framework informative for understanding behavioral intentions and choices during exceptional and uncommon circumstances, such as a pandemic of respiratory infectious disease. PMT postulates both the threat appraisal and the coping appraisal as predictors of health behaviors. Recent advances in the field of behavioral immune system (BIS) research suggest that humans are equipped with a set of psychological adaptations enabling them to detect the disease-threat and activate behavioral avoidance of pathogens. The present study, set within PMT framework and informed by the BIS research, aimed to explain and predict voluntary adherence to COVID-19 guidelines by perceived personal risk and vulnerability to disease as threat appraisal variables, and trust in science as the response efficacy element of coping appraisal. Gender, age, belief in the second wave, perceived personal risk, germ aversion, and trust in science were all found to be significant positive predictors of the intent to adhere to non-pharmacological COVID-19 recommendations, with the belief in the second wave, germ aversion, and trust in science being the most important ones. On the other hand, only the belief in the second wave and trust in science were significant positive predictors of the intent to adhere to pharmacological COVID-19 recommendations (i.e., to vaccinate). Interventions aimed at enhancing preventative measures adherence should take into account that the psychological mechanisms underlying adherence to these two types of recommendations are not identical.

Keywords: protection motivation theory, adherence to protective measures, behavioral immune system, perceived vulnerability, trust in science

INTRODUCTION

While scientific and pharmacological efforts are globally being put forth into the development and distribution of vaccines, non-pharmacological recommendations (NPR, e.g., handwashing, physical distancing) remain a key individual mean of limiting COVID-19 (World Health Organization, 2020a). As documented in previous pandemics, public consent to WHO guidelines is challenging to achieve (Gilles et al., 2011; Shultz et al., 2015). According to health behavior theories, the adherence to NPR is determined by the cost-benefit analysis of recommended behaviors. Individual determinants of preventive behavior span from demographics to attitudes and beliefs (e.g., Clark et al., 2020). Given the high infectivity of COVID-19 (leading to 122 M cases and 2.69 M

deaths worldwide, as of March 19th; WHO), the potential harm caused by even a single non-compliance with NPR can have exponential negative effects for a number of persons. Even with an unlikely scenario of world-wide high adherence to NPR, further spread of pandemic cannot be seized without a satisfactory vaccination rate (estimated at 70% of the population; Randolph and Barreiro, 2020). Given the surge in global anti-vaccination and anti-scientific movements (Hussain et al., 2018; Hotez, 2020), this endeavor proves to be even more difficult.

When a global plan is founded on individual actions, promoting the understanding of individual adherence to health guidelines is of utmost importance – it could improve informing the public and in turn raise adherence. Also, such insights are instrumental for future health prevention programs. In the present study, we have examined individual demographics and beliefs regarding COVID-19, set within the protection motivation theory (PMT, e.g., Floyd et al., 2000; Boer and Mashamba, 2005; Al-Rasheed, 2020; Margraf et al., 2020) and informed by the behavioral immune system (BIS) research (Schaller, 2016). PMT framework is crucial in understanding behavioral choices during exceptional and uncommon circumstances, with epidemics of respiratory infectious disease being among the most serious of them (e.g., Williams et al., 2015). In so far, PMT has served to explore preventive behaviors related to the seasonal influenza vaccination (Ling et al., 2019), sun-safe behavior (Lowe et al., 2000; Moeini et al., 2019), and SARS preventive behaviors (Jiang et al., 2009). According to PMT, protective motivation depends on the threat and coping appraisal.

Coping appraisal taps beliefs about risk minimization, either at individual (such as perceived self-efficacy or one's own perceived coping resources; e.g., Milne et al., 2000) or group level response (such as trust in policy-makers or science; e.g., Plohl and Musil, 2020). Response efficacy concerns beliefs that adopting a particular behavioral response will be effective in reducing the diseases' threat (Van der velde and Van der Plicht, 1991) and is operationalized by linking consequences and their likelihood to the recommended behavior (Lwin and Saw, 2007). Given the growing world-wide anti-scientific sentiment – perils of which became obvious during the COVID-19 pandemic (e.g., distrust in scientific authorities regarding the face-masks, social distancing, asymptomatic transmission, and above all vaccine's safety and efficacy), we opted to explore the relation between (mis)trust in both, science as an epistemic process and scientists as those conducting it, and the self-reported intent to adhere to the official COVID-19 guidelines. As previous studies suggest (e.g., Organization for Economic Co-operation and Development, 2020; Plohl and Musil, 2020), individuals placing trust in expert decision-makers will be more likely adhere to the guidelines. In the context of the coping appraisal within the PMT, we hypothesized that individuals with higher scores on the *Trust in Science and Scientists Inventory* (TSSI; Nadelson et al., 2014) will follow the COVID-19 guidelines more diligently.

Threat appraisal regards personal beliefs about the likelihood of contracting a disease and/or perceived vulnerability or risk. We opted to explore this part of the PMT in relation to the BIS. Stemming from the evolutionary psychology framework, BIS is defined as a set of cognitive and affective mechanisms

(psychological adaptations) which enable detection of potential pathogens in the immediate environment and trigger avoidant and prophylactic behaviors (Schaller, 2006, 2016). BIS has been extensively studied on the perceptual (detection of pathogens ranging from perceived sources of contamination in public toilets to detection of subtler cues of illness among conspecifics) or affective-cognitive level (emotions and cognitions related to BIS-activation; i.e., negative emotions and avoidance motivations). In this study, we investigated the behavioral correlate of BIS activation (i.e., adherence to the COVID-19 guidelines). BIS activation is largely emotion-driven thus often unconscious and automatic. Yet, triggered prophylactic behaviors also include rational, conscious choices, such as vaccination or avoidance of public transportation during the flu season (Schaller, 2016).

The general purpose of BIS is the avoidance of pathogens and infective carriers and the expression of such adaptation is expected throughout the whole species. However, individuals vary regarding the BIS reactivity, and studies suggest these variations are related to one's health status. For example, recently and frequently ill people show greater BIS activation (Stevenson et al., 2009; Miller and Maner, 2011; Murray et al., 2019), as do pregnant women during the first trimester (Navarrete et al., 2007), and individuals with gene variants associated with greater susceptibility to certain infectious diseases and poorer immunological function (MacMurray et al., 2014; Napolioni et al., 2014).

While perceived infectability refers to one's own susceptibility to infection, germ aversion covers behaviors exerting emotional discomfort in high pathogen context, in turn deterring from the source of infection. These two pathogen avoidance tendencies jointly measure perceived vulnerability to disease (Duncan et al., 2009) and are often operationalized as a trait. However, group level scores on disgust sensitivity, germ aversion, and perceived infectability have risen significantly during the current unprecedented global health crisis (Hromatko et al., 2021; Miłkowska et al., 2021; Stevenson et al., 2021), indicating that heightened awareness of potential contamination cues might lead to a sensitization to pathogen threat, i.e., greater (re)activity of BIS. The perceived vulnerability to disease is associated with stronger reactions to the COVID-19 threat, including increased anxiety, need for behavioral change, and higher importance of proactive behavior and social distancing (Makhanova and Shepherd, 2020). Converging onto the context of threat appraisal within the PMT, we hypothesized that individuals with higher scores on BIS-related variables (germ aversion and perceived infectability) and perceived personal risk (a one-item measure exploring whether participants perceived themselves to be at higher risk of COVID-19) will, again, be more diligent in following guidelines.

Finally, demographic variables could also affect adherence, either directly or indirectly *via* other important variables. Higher education and SES are predictive of trust in science (Nadelson et al., 2014; Peterlin, 2019). Women are more likely to engage in NPR and related health-behavior (Yıldırım and Güler, 2020; Yıldırım et al., 2021). Furthermore, women consistently score higher on disgust sensitivity (Al-Shawaf et al., 2018), which is central to BIS activation. However, age was not found related to voluntary adherence to NPR (Clark et al., 2020), although it was implicated in some BIS-related outcomes: for example, older participants preferred larger interpersonal distance during pandemic (Hromatko et al., 2021).

Aim

We aimed to explain and predict voluntary adherence to COVID-19 guidelines *via* perceived personal risk and perceived vulnerability to disease as threat appraisal variables, and trust in science as the efficacy element of the coping appraisal. Since this study was conducted between the two waves of COVID-19 pandemic in Croatia, the adherence was operationalized as participants' *intent* to adhere to recommendations *if/when the second wave occurs*. The rationale was led by the fact that the first wave was successfully mitigated with the most restrictive set of measures (acc. to the Oxford stringency index: Hale et al., 2020), and the data collection period was preceded by almost 2 months of sporadic new cases. Even though health authorities kept issuing warnings of high probability of the second wave, general public was only moderately convinced (see **Figure 1**). Therefore, we measured and controlled for belief in the possibility of the second wave, with a prediction that this variable will explain significant proportion of the variance in the intent to adhere to the guidelines. In all, we hypothesized that the higher both of the two types of appraisals (threat and coping), the higher the compliance with the COVID-19 guidelines.

MATERIALS AND METHODS

Participants

Among 859 participants (375 male, 457 female, and 27 did not report gender), aged 16–73 ($M = 28.18$, $SD = 11.81$), 54.7% have finished elementary or high school, 21.1% had a bachelor

degree, 17.8% had a graduate level degree (MA), and 6.3% a postgraduate degree (PhD).

Procedure

The link to the questionnaire was posted on various social networks during first 2 weeks of June, 2020. As explained, this period was preceded by almost 2 months of only sporadic new cases, i.e., the number of newly confirmed 3-day moving average cases ranged from 0 to 3 throughout May and June (Worldometer, 2021), and took place at the mere onset of the second wave (**Figure 1**).

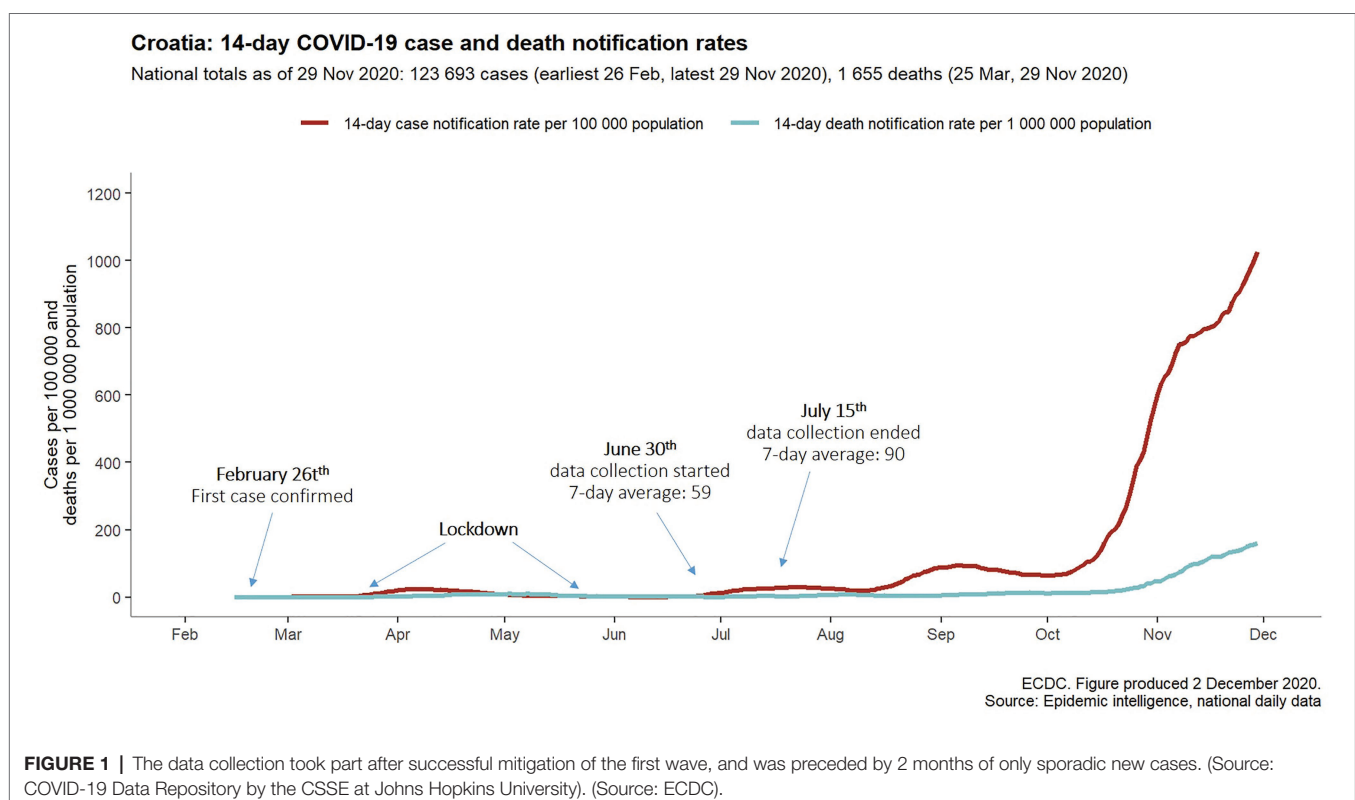
Upon given an informed consent, participants have proceeded to the initial questionnaire consisting of: (1) sociodemographic information, (2) a question about belief in the second wave and, (3) a question regarding the perceived personal risk. Following this, participants filled in the instruments described below.

Instruments

Sociodemographic Information

Participants reported their gender, age, education (elementary school/high school/undergraduate level/master/postgraduate level), and the population of their place of residence (eight-point scale, ranging from below 2,000 to over 200,000 inhabitants).

Belief in the second wave was measured on a five-point scale grading one's agreement with the statement *I believe that the second wave of the pandemic will come (or has already started)*.



Perceived Personal Risk

One-item in which participants were asked whether they or their significant others belong to the COVID-19 high-risk group (e.g., whether they are older or immunocompromised, have chronic disease, asthma or similar; importantly, we did not define a high-risk group; rather we allowed for participants' self-assessment of whether they are likely to develop a complicated presentation of COVID-19 infection).

*Intent to Adhere to COVID-19 Preventive Measures Scale (IA-COVID-19)*¹ is a 12-item scale developed for the purpose of this study to examine the adherence intent during the next wave of pandemic (for example: *If the second wave occurs, I will... avoid closed and crowded spaces*). Participants report their intent to adhere to each of measures on a five-point scale (1 = *I do not plan to do that*, 5 = *Yes, I will definitely do that*). Final analysis yielded one-factor solution with 10 items ($\alpha = 0.88$), while two items with low loadings were omitted. One of these items was "*I will take a COVID-19 vaccine*," which is an important health-related behavior during the pandemic, and we have investigated it separately thus differentiating between the intent to adhere to pharmacological vs. NPR.

Perceived Vulnerability to Disease Scale

The scale consists of two subscales: (1) *Perceived Infectability* (seven items), assessing beliefs about one's susceptibility to infectious diseases and (2) *Germ Aversion* (eight items), assessing emotional discomfort in contexts that connote especially high potential for pathogen transmission. Participants indicate their agreement with the items on a seven-point scale (1 = strongly disagree, 7 = strongly agree) with mean result as a subscale score. Reliabilities of *Perceived Infectability Subscale* and *Germ Aversion Subscale* are $\alpha = 0.87$ and $\alpha = 0.74$, respectively (Duncan et al., 2009).

Trust in Science and Scientists Inventory

A 21-item scale was shortened to a 13-item form based on the previous studies (Peterlin, 2019). Responses are given on a five-point Likert scale (1 = extremely disagree; 5 = extremely agree) and such scale showed high internal validity ($\alpha = 0.88$; Nadelson et al., 2014).

RESULTS

Descriptive statistics and correlations are shown in **Table 1**. Approximately, one half of participants (55.2%) considered themselves or their significant others to be in a COVID-19 high-risk group.

Originally, one hierarchical regression analysis was planned, with sociodemographics (gender, age, and education) entered as the first, threat appraisal variables [perceived vulnerability to disease scale (PVD) and perceived personal risk] as the second, and coping appraisal variables (measures efficacy,

operationalized *via* TSSI) as the third block of predictors, with the intent to adhere as a criterion variable. However, as described in the instruments section, the IA-COVID-19 showed a two-factor structure, with majority of items loading onto the factor best described as adherence to NPR and the item about the intent to vaccinate loading onto a second factor; such a finding is easily interpretable as the vaccination is not a NPR. Therefore, we have conducted two regression analyses as described above; first with the intent to adhere to NPR as the criterion and the second with the intent to vaccinate as the criterion.

Intent to Adhere to the NPR

As previously stated, we hypothesized that sociodemographics, belief in the second wave, perceived personal risk, perceived infectability, germ aversion, and trust in science and scientists can significantly contribute to individual differences in adherence to the COVID-19 recommendations. Sensitivity analysis conducted in G*Power 3.1 (Faul et al., 2009) revealed that with our sample of $N = 859$ participants, regression analysis with nine predictors has 0.9 power ($\alpha = 0.05$) to detect small effect size of $f^2 = 0.02$ (Cohen, 1988). A three-step multiple regression analysis described above was conducted. Regression statistics are shown in **Table 2**.

Sociodemographics and belief in the second wave one accounted for 12.8% of the variation in intent to adhere to NPR. Women, older participants and those believing in the second wave had a higher intent to adhere to NPR. Adding perceived personal risk and perceived vulnerability to disease explained an additional 7.6% of criterion variance. This change was significant [$F(3, 675) = 21.5$; $p < 0.001$]. Participants who considered themselves or their significant others to be in high-risk COVID-19 group, and those with higher germ aversion had a higher adherence intent. Finally, trust in science and scientists entered in the third step explained additional 2.6% of intent to adhere to NPR. This change was also significant [$F(1, 674) = 22.5$; $p < 0.001$]. Gender, age, belief in the second wave, perceived personal risk, germ aversion, and trust in science and scientists were significant positive predictors in the final model with the belief in the second wave, germ aversion, and trust in science and scientists being the most important ones and accounting for 23% of the variance of the intent to adhere to NPR.

Intent to Vaccinate

Again, a three-step multiple regression was conducted and the regression statistics are shown in **Table 3**. Sociodemographics and belief in the second wave accounted for 6.7% of the variation in the intent to vaccinate. Those believing in the second wave were more prone to vaccination. Adding perceived personal risk and perceived vulnerability to disease did not significantly contribute to the explanation of the criterion variance [$F(3, 675) = 0.79$; $p = 0.50$]. Finally, trust in science and scientists entered in the third step explained another 10% of the intent to vaccinate. This change was significant [$F(1, 674) = 80.8$; $p < 0.001$]. Only the belief in the second wave and trust in science and scientists were significant positive

¹The full scale is available at <https://osf.io/j47qh/>.

TABLE 1 | Correlation matrix and descriptive statistics.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
1 NPR adherence intent	3.65	0.87	—									
2 Intent to vaccinate	3.25	1.52	0.38**	—								
3 Gender			0.12**	-0.04	—							
4 Age	28.2	11.80	0.12**	-0.02	-0.08*	—						
5 Education	2.74	0.99	0.09**	0.03	-0.09**	0.63**	—					
6 Residence size	6.44	2.25	0.06	0.05	-0.13**	0.10**	0.18**	—				
7 Belief in the second wave	3.86	1.16	0.30**	0.24**	-0.02	-0.16**	-0.06	0.11**	—			
8 Perceived personal risk	2.98	0.85	0.15**	0.06	0.08*	-0.02	-0.01	<0.01	0.14**	—		
9 Perceived infectability	4.27	0.93	0.09*	-0.01	0.04	-0.03	-0.03	0.06	0.05	0.10**	—	
10 Germ aversion			0.27**	0.03	0.12**	0.10**	<0.01	-0.05	-0.02	0.01	0.19**	—
11 Trust in science and scientists	3.78	0.71	0.19**	0.37**	-0.10**	<-0.01	0.03	0.16**	0.21**	0.04	-0.05	-0.04

p* < 0.05; *p* < 0.01.

predictors in the final model, accounting for 16.9% of the variance in intent to vaccinate.

DISCUSSION

This study aimed to explore the role of perceived personal risk and vulnerability to disease as threat appraisal variables and trust in science and scientists as a coping appraisal variable in intent to adhere to the official COVID-19 recommendations. Our model yielded a significant proportion of explained variance, and as expected – both types of appraisals contributed significantly to the explanation of variance of the intent to adhere to COVID-19 prevention measures.

Adherence to NPRs vs. the Intent to Get Vaccinated

Women, older participants, and those believing in the second wave were more likely to adhere to the NPRs. Some studies have found age to be unrelated to voluntary compliance behavior, yet their participants were mostly young (mean age 27.2; Clark et al., 2020). A small positive correlation of age and intent to adhere is not entirely unexpected because the real risk of infection increases with age. BIS variables (perceived risk and vulnerability to disease) have explained 7.6% of the variance, while adding trust in science and scientists has explained additional 2.6%. Thus, gender, age, belief in the second wave, perceived risk, germ aversion, and trust in science and scientists are all significant positive predictors of the intent to adhere to NPR, with the belief in the second wave, germ aversion, and trust in science being the most important ones. The finding that germ aversion, but not perceived infectability predicted NPR adherence is in line with the recent finding of germ aversion being more associated with actions and perceived infectability with attentiveness (Makhanova and Shepherd, 2020). Our two sets of predictors represent two foundation blocks of the PMT, i.e., threat and coping appraisal, respectively. Protection motivation is considered synonymous with behavioral intent and is regarded as a strong mediator of the relation between both types of appraisal and subsequent behavior. The meta-analysis of 21 primary studies finds variables pertaining to each appraisal to be significantly correlated with the behavioral intention (Milne et al., 2000).

Regarding the intent to get vaccinated, only the belief in the second wave and trust in science proved to be significant predictors. Vaccination is a preventive measure whose mechanism of action is not easily understood by general public and which is held risky by lay-people. This is especially evident nowadays in the abundance of misinformation about vaccination, and during the mass vaccination campaign when each potential adverse effect is scrutinized and immediately picked by the social media platforms or mainstream news services. Even though the vaccine development is more transparent than ever, conspiracy theories thrive (Uscinski et al., 2020; Douglas, 2021). In order to suppress fears driven by the lack of understanding of the mechanisms underlying vaccines' effects, one needs to

TABLE 2 | Summary of hierarchical regression analysis for variables predicting the intent to adhere to COVID-19 preventive measures.

Variable	Step 1			Step 2			Step 3		
	B	SE	β	B	SE	β	B	SE	β
Gender	0.26	0.06	0.15**	0.17	0.06	0.10**	0.20	0.06	0.11**
Age	0.01	<0.01	0.18**	0.01	<0.01	0.13**	0.01	<0.01	0.13**
Education	<0.01	0.04	<0.01	0.02	0.04	0.03	0.02	0.04	0.02
Residence size	0.01	0.01	0.04	0.02	0.01	0.04	0.01	0.01	0.02
Belief in the second wave	0.23	0.03	0.30**	0.22	0.03	0.29**	0.20	0.03	0.25**
Perceived personal risk				0.19	0.06	0.11**	0.18	0.06	0.10**
Perceived infectability				0.01	0.04	0.01	0.03	0.04	0.03
Germ aversion				0.24	0.03	0.26**	0.24	0.03	0.26**
Trust in science and scientists							0.21	0.04	0.17**
R^2		0.13			0.20			0.23	
ΔR^2		0.13**			0.08**			0.03**	

** $p < 0.01$.**TABLE 3** | Summary of hierarchical regression analysis for variables predicting the intent to vaccinate against COVID-19.

Variable	Step 1			Step 2			Step 3		
	B	SE	β	B	SE	β	B	SE	β
Gender	-0.18	0.11	-0.06	-0.20	0.11	-0.07	-0.01	0.11	-0.04
Age	<-0.01	0.01	-0.01	<-0.01	0.01	-0.02	<-0.01	0.01	-0.01
Education	0.05	0.08	0.03	0.06	0.08	0.04	0.03	0.07	0.02
Residence size	<0.01	0.03	0.01	0.01	0.03	0.01	-0.03	0.02	-0.04
Belief in second wave	0.33	0.05	0.25**	0.33	0.05	0.24**	0.24	0.05	0.18**
Perceived personal risk				0.11	0.12	0.04	0.09	0.11	0.03
Perceived infectability				-0.06	0.07	-0.04	-0.02	0.06	-0.01
Germ Aversion				0.06	0.06	0.04	0.07	0.06	0.05
Trust in Science and Scientists							0.70	0.08	0.33**
R^2		0.07			0.07			0.17	
ΔR^2		0.07**			<0.01			0.10**	

** $p < 0.01$.

have considerable trust in both, science/scientists and policy-makers. On the other hand, successful implementation of non-pharmacological measures does not require much knowledge and carries low risk. They are adhered to by those who are otherwise more sensitized to risks of contracting a disease, and show higher trait pathogen-avoidance. We believe this is the main reason why trust in science explains only an additional proportion of variance in adherence to the NPRs, and is, at the same time, the most significant predictor of adherence to the pharmacological measure.

The intent to vaccinate depends upon people's perception of risk to contract a disease (Baumgaertner et al., 2020), thus we have expected for perceived vulnerability to predict intent to vaccinate as well. The reason why PVD did not predict the intent to vaccinate in this study might lie in the general nature of this measure: it measures pathogen avoidance as a

trait, and this trait is usually expressed as disgust induced by (not necessarily conscious) detection of contamination risk. The intent to vaccinate is a deliberate, conscious choice, which might not be entirely reflected in one's germ aversion or general infectability. A more specific measure regarding the perceived risks of contracting COVID-19 might prove to be more useful in explaining the willingness to vaccinate.

Implications of This Study

This study was set as a synthesis of two different theoretical frameworks: the PMT and the BIS research. Both of them interpret certain motivations, and since BIS is more specifically oriented toward disease avoidance, it provided a more precise input for the conceptualization of the threat appraisal. Therefore, it comes as no surprise that BIS-informed threat appraisals have explained a significant share of the intent to adhere to NPR.

Recent findings show that PVD: (1) has shifted significantly as a function of pandemic (Miłkowska et al., 2021; Stevenson et al., 2021), (2) can be manipulated experimentally (participants who read the coronavirus morbidity-mortality statistics and/or the government lifestyle regulations scored higher on PVD, compared to those who did not read such information; Bacon and Corr, 2020), and (3) predicts preventative behaviors (Makhanova and Shepherd, 2020; Shook et al., 2020; Stangier et al., 2021). It seems that tapping these evolved psychological mechanisms could prove instrumental for public interventions aiming to enhancing voluntary adherence to guidelines. For example, 55% of our participants reported perceiving themselves/their significant-others to be at high risk, and this perception correlated significantly with the intention to adhere to preventive measures. Thus interventions aiming at those not perceiving themselves to be at high risk might try to catalyze their personal threat appraisals by explaining the implications of large numbers: even though SARS-CoV-2 complications are more likely to occur among the identified high-risk populations, higher incidence of infection comes with a higher absolute numbers of fatalities even among young and healthy individuals.

Prophylactic behaviors seem to be common sense just as the findings of high-risk individuals to adhere more to the health guidelines. However, throughout the past year, a surprising amount of resistance to NPR was reported, often leading to societal polarization and culminating in street riots (Triani, 2020). Since humans are motivated to avoid disease, how did this resistance come into effect? Such motivations might be fueled by the appraisals stemming from the coping appraisals part of the PMT – here operationalized as the (mis)trust in science. Along with a pandemic, we are currently also dealing with an infodemic (World Health Organization, 2020b). The average reader is not well-equipped with skills and knowledge needed to differentiate between science and pseudoscience, false news, and checked facts. Interventions aimed at preventing a widespread gullibility will require meticulous planning and long-term goals. One such goal might be the augmentation of the public's trust in science. In this study, the largest proportion of variance in the intent to vaccinate was explained by the trust in science. Mistrust in science, more specifically in vaccines, spreads across several domains: mistrust in benefits, worries of unforeseen effects, preference for natural immunity, and concerns about profiteering (Paul et al., 2020). Conspiratorial thinking and cognitive fallacies (including the so-called *argumentum ad big pharma*, see, e.g., Blaskiewicz, 2013) are deeply rooted in the popular narrative and it might prove counterproductive to address them directly. Elevating the trust in science as a general knowledge-augmenting process might induce less opposition. For example, one of the domains of mistrust in COVID-19 vaccine – “the preference for natural immunity” – might be changed when faced with the information that infecting a significant proportion of population might result in up to 30 million deaths worldwide (Randolph and Barreiro, 2020).

Limitations of This Study

Apart from the well-established shortcomings of online surveys, such as respondents' bias and unconscientious responses, this study

features a potential flaw inherent to studies regarding behavioral intent – the so-called “intention-behavior gap” (Williams et al., 2015) or the discrepancy between intended and actual behavior. Future studies on preventive behavior and adherence to NPR should wisely incorporate measures of actual behavior as adherence criterion. It should be noted though, that a meta-analysis including approximately 30,000 participants showed that in general, increases in threat severity, vulnerability, response efficacy, and self-efficacy facilitates adaptive intentions or behaviors, irrespective of whether the measures were based on intentions or behaviors (Floyd et al., 2000), thus indicating the usefulness of PMT components for individual and community interventions. Furthermore, like any online sample, ours might have been biased regarding both demographic and relevant personality characteristics – women and participants higher on conscientiousness and agreeableness are more likely to participate (e.g., Bethlehem, 2010). However, our sample is rather diverse, with age spanning over 50 years, education ranging from elementary to PhD level, and a balanced gender proportion (44% men). Additionally, 87.7% of participants answered all of the questions.

In conclusion, we have found that both the BIS variables (entered as the threat appraisal within the model) and the trust in science (entered as the coping appraisal part of the model) contribute significantly to the intent to adhere to NPR, while only trust in science contributed significantly to the intent to vaccinate. Thus, interventions aimed at enhancing guidelines adherence should take into account that the psychological mechanisms underlying adherence to these two types of recommendations might not be identical, i.e., that the adherence to non-pharmacological measures is associated with threat and coping appraisal, while the intent to vaccinate is dominantly predicted by the response efficacy (an element of coping appraisal), such as trust in science or policy-makers.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Dept. of Psychology, University of Zagreb. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AV, IH, and MT contributed to the conception and design of the study and wrote the sections of the manuscript. MT organized the database. MT and IH performed the statistical analysis. AV and IH wrote the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

REFERENCES

- Al-Rasheed, M. (2020). Protective behavior against covid-19 among the public in Kuwait: an examination of the protection motivation theory, trust in government, and sociodemographic factors. *Soc. Work Public Health* 35, 546–556. doi: 10.1080/19371918.2020.1806171
- Al-Shawaf, L., Lewis, D. M. G., and Buss, D. M. (2018). Sex differences in disgust: why are women more easily disgusted than men? *Emot. Rev.* 10, 149–160. doi: 10.1177/1754073917709940
- Bacon, A. M., and Corr, P. J. (2020). Behavioral immune system responses to coronavirus: a reinforcement sensitivity theory explanation of conformity, warmth toward others and attitudes toward lockdown. *Front. Psychol.* 11:566237. doi: 10.3389/fpsyg.2020.566237
- Baumgaertner, B., Ridenhour, B. J., Justwan, F., Carlisle, J. E., and Miller, C. R. (2020). Risk of disease and willingness to vaccinate in the United States: a population-based survey. *PLoS Med.* 17:e1003354. doi: 10.1371/journal.pmed.1003354
- Bethlehem, J. (2010). Selection bias in web surveys. *Int. Stat. Rev.* 78, 161–188. doi: 10.1111/j.1751-5823.2010.00112.x
- Boer, H., and Mashamba, M. T. (2005). Psychosocial correlates of HIV protection motivation among black adolescents in Venda, South Africa. *AIDS Edu. Prev.* 17, 590–602. doi: 10.1521/aeap.2005.17.6.590
- Blaskiewicz, R. (2013). The big Pharma conspiracy theory. *Medical Writ.* 22, 259–261. doi: 10.1179/2047480613Z.000000000142
- Clark, C., Davila, A., Regis, M., and Kraus, S. (2020). Predictors of COVID-19 voluntary compliance behaviors: an international investigation. *Glob. Transit.* 2, 76–82. doi: 10.1016/j.glt.2020.06.003
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. 2nd Edn. Hillsdale, NJ: Erlbaum.
- Douglas, K. (2021). COVID-19 conspiracy theories. *Group Process. Intergroup Relat.* 24, 270–275. doi: 10.1177/1368430220982068
- Duncan, L. A., Schaller, M., and Park, J. H. (2009). Perceived vulnerability to disease: development and validation of a 15-item self-report instrument. *Personal. Individ. Differ.* 47, 541–546. doi: 10.1016/j.paid.2009.05.001
- Faul, F., Erdfelder, E., Buchner, A., and Lang, A.-G. (2009). Statistical power analyses using G*power 3.1: tests for correlation and regression analyses. *Behav. Res. Methods* 41, 1149–1160. doi: 10.3758/BRM.41.4.1149
- Floyd, D. L., Prentice-Dunn, S., and Rogers, R. W. (2000). A meta-analysis of research on protection motivation theory. *J. Appl. Soc. Psychol.* 30, 407–429. doi: 10.1111/j.1559-1816.2000.tb02323.x
- Gilles, I., Bangerter, A., Clémence, A., Green, E. G. T., Krings, F., Staerklé, C., et al. (2011). Trust in medical organizations predicts pandemic (H1N1) 2009 vaccination behavior and perceived efficacy of protection measures in the Swiss public. *Eur. J. Epidemiol.* 26, 203–210. doi: 10.1007/s10654-011-9577-2
- Hotez, P. J. (2020). Combating antisense: are we preparing for the 2020s? *PLoS Biol.* 18:e3000683. doi: 10.1371/journal.pbio.3000683
- Hromatko, I., Grus, A., and Kolderaj, G. (2021). Do islanders have a more reactive behavioral immune system? Social cognitions and preferred interpersonal distances during the COVID-19 pandemic. *Front. Psychol.* 12:647586.
- Hussain, A., Ali, S., Ahmed, M., and Hussain, S. (2018). The anti-vaccination movement: a regression in modern medicine. *Cureus* 10:e2919. doi: 10.7759/cureus.2919
- Jiang, X., Elam, G., Yuen, C., Voeten, H., de Zwart, O., Veldhuijzen, I., et al. (2009). The perceived threat of SARS and its impact on precautionary actions and adverse consequences: a qualitative study among Chinese communities in the United Kingdom and the Netherlands. *Int. J. Behav. Med.* 16, 58–67. doi: 10.1007/s12529-008-9005-5
- Ling, M., Kothe, E. J., and Mullan, B. A. (2019). Predicting intention to receive a seasonal influenza vaccination using protection motivation theory. *Soc. Sci. Med.* 233, 87–92. doi: 10.1016/j.socscimed.2019.06.002
- Lowe, J. B., Borland, R., Stanton, W. R., Baade, P., White, V., and Balanda, K. P. (2000). Sun-safe behaviour among secondary school students in Australia. *Health Educ. Res.* 15, 271–281. doi: 10.1093/her/15.3.271
- Lwin, M., and Saw, S. (2007). Protecting children from myopia: a PMT perspective for improving health marketing communications. *J. Health Commun.* 12, 251–268. doi: 10.1080/10810730701266299
- MacMurray, J., Comings, D. E., and Napolioni, V. (2014). The gene-immune-behavioral pathway: gamma-interferon (IFN- γ) simultaneously coordinates susceptibility to infectious disease and harm avoidance behaviors. *Brain Behav. Immun.* 35, 169–175. doi: 10.1016/j.bbi.2013.09.012
- Makhanova, A., and Shepherd, M. (2020). Behavioral immune system linked to response to the threat of COVID-19. *Pers. Individ. Differ.* 167:110221. doi: 10.1016/j.paid.2020.110221
- Margraf, J., Brailovskaia, J., and Schneider, S. (2020). Behavioral measures to fight COVID-19: An 8-country study of perceived usefulness, adherence and their predictors. *PLoS One* 15:e0243523. doi: 10.1371/journal.pone.0243523
- Milkowska, K., Galbarczyk, A., Mijas, M., and Jasienska, G. (2021). Disgust sensitivity among women during the COVID-19 outbreak. *Front. Psychol.* 12:622634. doi: 10.3389/fpsyg.2021.622634
- Miller, S. L., and Maner, J. K. (2011). Sick body, vigilant mind: the biological immune system activates the behavioral immune system. *Psychol. Sci.* 22, 1467–1471. doi: 10.1177/0956797611420166
- Milne, S., Sheeran, P., and Orbell, S. (2000). Prediction and intervention in health-related behavior: a meta-analytic review of protection motivation theory. *J. Appl. Soc. Psychol.* 30, 106–143. doi: 10.1111/j.1559-1816.2000.tb02308.x
- Moeini, B., Ezati, E., Barati, M., Rezapur-Shahkolai, F., Gholi Mezerji, N. M., and Afshari, M. (2019). Skin cancer preventive behaviors in Iranian farmers: applying protection motivation theory. *Workplace Health Saf.* 67, 231–240. doi: 10.1177/2165079918796850
- Murray, D. R., Prokosch, M. L., and Airington, Z. (2019). PsychoBehavioroimmunology: connecting the behavioral immune system to its physiological foundations. *Front. Psychol.* 10:200. doi: 10.3389/fpsyg.2019.00200
- Nadelson, L., Jorczyk, C., Yang, D., Jarratt Smith, M., Matson, S., Cornell, K., et al. (2014). I just don't trust them: the development and validation of an assessment instrument to measure trust in science and scientists. *Sch. Sci. Math.* 114, 76–86. doi: 10.1111/ssm.12051
- Napolioni, V., Murray, D. R., Comings, D. E., Peters, W. R., Gade-Andavolu, R., and MacMurray, J. (2014). Interaction between infectious diseases and personality traits: ACP1* C as a potential mediator. *Infect. Genet. Evol.* 26, 267–273. doi: 10.1016/j.meegid.2014.06.002
- Navarrete, C. D., Fessler, D. M., and Eng, S. J. (2007). Elevated ethnocentrism in the first trimester of pregnancy. *Evol. Hum. Behav.* 28, 60–66. doi: 10.1016/j.evolhumbehav.2006.06.002
- Organization for Economic Co-operation and Development (2020). Trust in Government. Available at: <https://www.oecd.org/governance/trust-in-government.htm> (Accessed December 28, 2020).
- Paul, E., Steptoe, A., and Fancourt, D. (2020). Attitudes towards vaccines and intention to vaccinate against COVID-19: implications for public health communications. *Lancet* 1:100012. doi: 10.1016/j.lanepe.2020.100012
- Peterlin, M. (2019). Predictors of trust in science and scientists. Faculty of Humanities and Social Sciences. Unpublished master's thesis. Croatia: University of Zagreb.
- Plohl, N., and Musil, B. (2020). Modeling compliance with COVID-19 prevention guidelines: the critical role of trust in science. *Psychol. Health Med.* 26, 1–12. doi: 10.1080/13548506.2020.1772988
- Randolph, H. E., and Barreiro, L. B. (2020). Herd immunity: understanding COVID-19. *Immunity* 52, 737–741. doi: 10.1016/j.immuni.2020.04.012
- Schaller, M. (2006). Parasites, behavioral defenses, and the social psychological mechanisms through which cultures are evoked. *Psychol. Inq.* 17, 96–101. doi: 10.1207/s15327965pli1702_2
- Schaller, M. (2016). “The Behavioral Immune System,” in *The Handbook of Evolutionary Psychology*. ed. D. M. Buss (Hoboken, New Jersey: John Wiley & Sons, Inc.), 206–224.
- Shook, N. J., Sevi, B., Lee, J., Oosterhoff, B., and Fitzgerald, H. N. (2020). Disease avoidance in the time of COVID-19: The behavioral immune system is associated with concern and preventative health behaviors. *PLoS One* 15:e0238015. doi: 10.1371/journal.pone.0238015
- Shultz, J. M., Baingana, F., and Neria, Y. (2015). The 2014 ebola outbreak and mental health. *J. Am. Med. Assoc.* 313, 567–568. doi: 10.1001/jama.2014.17934
- Stangier, U., Kananian, S., and Schüller, J. (2021). Perceived vulnerability to disease, knowledge about COVID-19, and changes in preventive behavior during lockdown in a German convenience sample. *Curr. Psychol.* doi:10.1007/s12144-021-01456-6 [Epub ahead of print]

- Stevenson, R. J., Case, T. I., and Oaten, M. J. (2009). Frequency and recency of infection and their relationship with disgust and contamination sensitivity. *Evol. Hum. Behav.* 30, 363–368. doi: 10.1016/j.evolhumbehav.2009.02.005
- Stevenson, R. J., Saluja, S., and Case, T. I. (2021). The impact of the Covid-19 pandemic on disgust sensitivity. *Front. Psychol.* 11:600761. doi: 10.3389/fpsyg.2020.600761
- Triani, N. (2020). 2020: A year of protests and civil disobedience. France24. Available at: <https://www.france24.com/en/europe/20201228-2020-a-year-of-dissent-and-civil-disobedience> (Accessed December 28, 2020).
- Uscinski, J. E., Enders, A. M., Klofstad, C., Seelig, M., Funchion, J., Everett, C., et al. (2020). Why do people believe COVID-19 conspiracy theories? *HKS Misinform. Rev.* doi: 10.37016/mr-2020-015
- Van der Velde, F. W., and Van der Plicht, J. (1991). AIDS-related health behavior: coping, protection, motivation, and previous behavior. *J. Behav. Med.* 14, 429–451. doi: 10.1007/bf00845103
- Williams, L., Rasmussen, S., Kleczkowski, A., Maharaj, S., and Cairns, N. (2015). Protection motivation theory and social distancing behaviour in response to a simulated infectious disease epidemic. *Psychol. Health Med.* 20, 832–837. doi: 10.1080/13548506.2015.1028946
- World Health Organization (2020a). Coronavirus disease (COVID-19) advice for the public. Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public#:~:text=If%20COVID%2D19%20is%20spreading,Do%20it%20all> (Accessed December 28, 2020).
- World Health Organization (2020b). Call for action: Managing the infodemic. Available at: <https://www.who.int/news/item/11-12-2020-call-for-action-managing-the-infodemic> (Accessed December 28, 2020).
- Worldometer (2021). Croatia Coronavirus. Available at: <https://www.worldometers.info/coronavirus/country/croatia> (Accessed November 16, 2020).
- Yıldırım, M., Geçer, E., and Akgül, Ö. (2021). The impacts of vulnerability, perceived risk, and fear on preventive behaviours against COVID-19. *Psychol. Health Med.* 26, 35–43. doi: 10.1080/13548506.2020.1776891
- Yıldırım, M., and Güler, A. (2020). COVID-19 severity, self-efficacy, knowledge, preventive behaviors, and mental health in Turkey. *Death Stud.* 1–8. doi: 10.1080/07481187.2020.1818885 [Epub ahead of print]

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Boldness Personality Traits Are Associated With Reduced Risk Perceptions and Adoption of Protective Behaviors During the First COVID-19 Outbreak

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The containment measures imposed during the first COVID-19 outbreak required economic, social, and behavioral changes to minimize the spread of the coronavirus. Some studies have focused on how personality predicts distinct patterns of adherence to protective measures with psychopathic and antisocial traits predicting reduced engagement in such measures. In this study we extended previous findings by analyzing how boldness, meanness, and disinhibition psychopathic traits relate with both risk perceptions and protective behaviors during the first COVID-19 outbreak. A sample of 194 individuals (24% male) engaged in the survey, were assessed for psychopathic traits with the Triarchic Psychopathy Measure, and completed a COVID-19 survey targeting risk perceptions (spread, risk of becoming infected, state anxiety toward the COVID-19, and perceived risk of specific behaviors) and frequency of protective behaviors (e.g., not engaging in social distancing). Overall results show that boldness predicts reduced estimate of COVID-19 spread, reduced perceived risk of becoming infected, reduced state anxiety toward COVID-19, and reduced frequency of protective behaviors. Exploratory mediation models suggest that risk perceptions are not significant mediators of the association between psychopathic traits and reduced engagement in protective behaviors. Our results unveil that psychopathic traits affect risk perceptions and the propensity to engage in protective measures, emphasizing the need to accommodate these personality features in the public health strategy to control the COVID-19 spread.

Keywords: personality, psychopathic traits, COVID-19, risk perceptions, anxiety, protective behaviors

INTRODUCTION

Since its inception in December of 2019, the COVID-19 pandemic has left a devastating trail (Khalaf et al., 2020; Torequl Islam et al., 2020), with more than 94 million confirmed cases and more than 2 million deaths as of the second week of 2021 (ECDC, 2021). To slow down the spreading of the disease during the first outbreak, most countries responded to the COVID-19

spread by declaring state of emergency and mandatory confinement that markedly impacted the mental health of individuals (Mækelaë et al., 2020; Pfattheicher et al., 2020).

Despite the possible negative effects of confinement and social distancing, the governmental health control measures designed to prevent the spread of the virus play a pivotal role in controlling the COVID-19 pandemic. With notable few exceptions, over the last few months, public-health messages tried to increase the individual awareness and adherence to protective behaviors to which individuals reacted by diverse manners (Blagov, 2020). Being SARS-CoV-2 an invisible threat, individual behaviors may fall into one of two categories: (a) they may not consider it a real threat, and thus do not adhere to the protective control measures, such as ignoring social distancing, among others (Pfattheicher et al., 2020; Vieira et al., 2020; Wise et al., 2020); (b) individuals assume its ubiquity, and ultimately limit all their activities (Lanciano et al., 2020; Vieira et al., 2020). Both reactions have a considerable impact on both psychological functioning and behavior, ultimately triggering major issues on COVID-19 management and public health policies.

Being a predictor of health and health-related behaviors (Strickhouser et al., 2017), personality is one of the factors that may contribute to distinct individual reactions to government and public health-messages. In this context, psychopathic traits compose a set of personality features, including affective (e.g., lack of empathy, guilt, and deep emotional attachments to others) and interpersonal characteristics (e.g., superficial charm), as well as impulsive and antisocial behaviors (Hare and Neumann, 2008; Patrick and Drislane, 2015), that together have been linked to reduced risk perceptions and increased risk taking, including in health-related behaviors (Hudek-Knežević et al., 2007).

The modern operationalizations of psychopathy are inspired by the work of Cleckley, that in 1941 described several individuals who manifest severe impairments in personal and social functioning, but do not exhibit pathological externalizing symptoms, neither signs of dysfunctional reasoning (Cleckley, 1941). The characteristics of these individuals highlighted the presence of positive adjustment features, along with the display of persistent maladaptive behavior. Since then, neurobiological oriented models have provided evidence for two main etiological factors that underlie the expression of psychopathic traits: (a) dispositional fearlessness (or trait fearlessness), experimentally linked to a reduced reactivity to acute threats (Patrick, 1994; Blair, 2005; Paiva et al., 2020a); (b) externalizing vulnerability, experimentally linked to poor inhibitory control, and antisocial conducts (Patrick et al., 2009; Patrick and Bernat, 2010). Both dimensions represent two mechanisms that are critical for an adequate response to the COVID-19 challenges. On one hand, the trait fearlessness may boost the threat approach due to a reduced sensitivity to potentially harmful stimuli; on the other externalizing vulnerability entails lack of inhibitory control leading to risk taking and poor decision making. In this line, the triarchic operationalization of psychopathy defines three phenotypic constituents that characterize the psychopathic personality: (a) boldness, defined as the capacity to remain

calm and focused under pressure or threat, ability to recover from stressful situations, high self-assurance, and social efficacy; (b) meanness, associated with the maladaptive interpersonal characteristics of psychopathy, including low empathy, weak attachments with others, rebelliousness, excitement seeking, exploitativeness, and empowerment through cruelty; and (c) disinhibition, defined as the tendency to display problems of impulse control, including lack of planfulness and foresight, impaired regulation of affect and urges, reliance on immediate gratification, and deficient behavioral restraint (Patrick et al., 2009). A recent study found that distinct triarchic psychopathic traits predict specific behavioral patterns in the context of the COVID-19 pandemic (Blagov, 2020). Specifically, while all traits predicted increased venturous behavior in a carrier scenario, only meanness and disinhibition have been associated with a reduced intent to engage in protecting others, also predicting lower predisposition to engage in social distancing and hygiene protective behaviors. In addition, the authors also reported that meanness and disinhibition were negatively correlated with the appeal of public health messages. An independent study assessing the impact of antisociality on behaviors during the COVID-19 outbreak reported that individuals with high antisocial levels have more risky behaviors, such as not adopting social distance measures, leaving home more often, and curiously approaching even more closely to people when in public areas, possibly denoting a lower level of concern of becoming infected or infecting other individuals (O'Connell et al., 2020). On a Brazilian sample, Miguel et al. (2021) also found that antisocial traits (callousness, deceitfulness, and risk-taking, and low empathy) were associated with less compliance with containment measures.

Overall, the putative mechanisms underlying the expression of psychopathic traits (cf. trait fearlessness and externalizing vulnerability) seem to potentiate risk-related behaviors and potentially reduce the adherence to public health measures. Indeed, the triarchic psychopathic traits have been linked to psychological mechanisms and relevant behaviors in the context of the COVID-19 pandemic, further supporting our hypotheses: (a) boldness is associated with reduced reported anxiety and threat sensitivity (Paiva et al., 2020b), possibly reducing risk perceptions and the frequency of protective behaviors (Pasion et al., 2020; H1); (b) meanness relates to reduced empathic concern toward others overall disregard for authority (Patrick et al., 2009; Paiva et al., 2020b), being possibly associated with lower perceived probability of infecting others and reduced protective behaviors (H2); and (c) disinhibition represents a close correlation to antisocial behavior (Patrick et al., 2009), possibly related to disregard for protective recommendations, and thus to a reduced frequency of protective behaviors (H3). Additionally, we intended to test the mediating role of risk perceptions on the associations between psychopathic traits and adoption of protective behaviors through exploratory mediation analysis. Thus, by reporting data on the personality determinants of perceptions and behaviors associated with the COVID-19 pandemic, the present study may inform better approaches to public outreach in controlling the present and future outbreaks.

MATERIALS AND METHODS

Sample and Procedures

A total of 268 subjects enrolled in the study and were surveyed online. However, 69 participants did not complete any COVID-19-related section of the survey and were removed from the analysis. From the remaining 199 responses, we additionally excluded five participants that reported ages lower than 18 years old. The final sample included 194 individuals (24% male) with a mean age of 37.1 years old ($SD = 14.5$). Most of the sample completed the university (74.2%) or the secondary school (24.7%). For those actively working (71.6%) or studying (19.6%), 48.5% reported they were using online remote working. The zone of the residence covered the Portuguese national territory and was represented by both rural (27.8%) and urban areas (72.2%).

A power analysis estimate for linear multiple regression resulted on a sample size of 176 to detect effect sizes in the order of 0.3 ($\beta = 0.95$), suggesting that our sample size is adequate to detect effect sizes expected for correlations between self-report and behavioral measures (Hall et al., 2007).

Considering the recommendations for isolation and to minimize face-to-face interactions, participants were recruited by online advertisements on social media and on the university campus, and completed the survey online on Qualtrics (Qualtrics, Provo, UT, United States). The study was approved by the Local Ethics Committee and all participants gave informed consent before starting the survey.

Survey Development and Measures

The survey questions were adapted from Pasion et al. (2020). The survey collected data on sociodemographic characteristics, perceptions, and behaviors associated with the COVID-19, psychopathic traits, and anxiety. The survey questions are displayed in the **Supplementary Material** section (**Supplementary Table S1**).

COVID-19 Survey

We measured both risk perceptions on the COVID-19 pandemic and the reported frequency of protective behaviors (see Pasion et al., 2020). The main variables of interest to assess risk perceptions were: (a) *COVID-19 Reaction* – classification of the reactions of the government to the COVID-19 pandemic using a scale ranging from 1 = too extreme to 5 = very insufficient; (b) *Penalties* – classification of penalties from 0 to 10,000€ for not following important practices to mitigate dissemination risks (e.g., to go out with COVID-19 active symptoms); (c) *COVID-19 spread* – ratio of the estimates on the number of persons who will be contaminated with the coronavirus relative to the flu; (d) *Risk of infecting others* – probability of infecting someone in the future using a 0 to 100 scale, with 0 corresponding to “not likely at all” and 100 “to very likely”; (e) *Risk of becoming infected* – probability becoming infected in the future using a 0 to 100 scale, with 0 corresponding to “not likely at all” and 100 “to very likely”; (f) *Risk perceptions on high and low risk scenarios* – based on the local health department and WHO recommendations (e.g., to receive visits vs. to receive supplies

at the door) assessed from 0 – “not risky at all” to 100 – “very risky”; (g) *COVID-19 State-Anxiety* – measure adapted from the Hospital Anxiety and Depression Scale (Zigmond and Snaith, 1983; Portuguese version by Pais-Ribeiro et al., 2007) assessing anxiety states specifically related to COVID-19 circumstances (Pasion et al., 2020; e.g., “I feel tense or ‘wound up’ under the actual COVID-19 circumstances”) on a 4-point Likert scale ranging from 1 (never) to 4 (almost always). Finally, the (h) *Protective Behaviors* – frequency of engaging in protective behaviors in the last 5 days was analyzed considering the most reported official recommendations of the local health department at the time of data collection (e.g., to not physically compliment someone, to not attend to social events, and to cover the nose and the mouth when coughing or sneezing) were assessed on a 100-point scale (0 – “never” to 100 – “almost always”). Composite measures of risk perceptions and anxiety toward the COVID-19 revealed satisfactory internal consistency for risk perceptions in high risk ($Cronbach's\alpha = 0.78$) and low risk scenarios ($Cronbach's\alpha = 0.70$) and good internal consistency for state anxiety ($Cronbach's\alpha = 0.80$).

Psychopathic Traits

The Triarchic Psychopathy Measure (TriPM) is a 58-item (Patrick, 2010), self-report questionnaire developed to measure the three psychopathic dimensions of the triarchic model of Psychopathy (Patrick et al., 2009): *boldness* is assessed by a 19-item subscale addressing optimism, resilience to stress, social dominance, persuasiveness, tolerance for uncertainty, self-confidence, social assurance, and intrepidity; *meanness* is assessed by a 19-item subscale addressing empathy, relational aggression, destructive aggression, physical aggression, honesty, and excitement-seeking; *disinhibition* is assessed by a 20-item subscale addressing irresponsibility, problematic impulsivity, theft, alienation, boredom proneness, impatient urgency, fraudulence, dependability, and lack of planful control. Items on all subscales are scored on a 4-point Likert scale with the following answers: false, somewhat false, somewhat true, and true. All participants completed the European Portuguese version of the TriPM (for details on the factor structure and validity see Paiva et al., 2020b). The three subscales revealed good internal consistency (all $Cronbach's\alpha > 0.78$).

Statistical Analysis

First, independent block-wise multiple linear regression models were performed using the Statistical Package for the Social Sciences (SPSS, v. 25, IBM Statistics, United States) software. The models tested the combined weight of psychopathic traits on perceptions and behaviors related to the COVID-19. The models were designed with psychopathic traits (boldness, meanness, and disinhibition) as predictors and COVID-19-related variables (risk perceptions and protective behaviors) as dependent variables. All variables revealed acceptable indicators of normality with absolute values of skewness < 0.99 and kurtosis < 1.29 . Additionally, the analysis of the scatterplots of the standardized residuals of the predictors and predicted values indicated homoscedasticity in the distribution of the residuals. Collinearity diagnosis also showed no multicollinearity among

predictors ($VIF < 2$). Then, for those variables yielding significant associations between psychopathic traits and COVID-19 related variables, mediation models were created using the mediation model #4 of the Process plugin for SPSS (v. 3.4; Hayes, 2018) with a 10,000 samples bias-corrected and accelerated bootstrap to test the mediation role of risk perceptions in the association between psychopathic traits (predictors) and protective behaviors (outcome variable). As so, the mediation models were exploratory and designed following two main criteria: (a) the model had to include a psychopathic trait as predictor, behavior as outcome, and risk perception (e.g., perceived risk) as mediator (i.e., a model where personality traits are independent variables and risk perception is a psychological process that also influences behavior); and (b) only variables yielding significant associations in the regression analysis were included. The statistical threshold for significance was defined at $\alpha = 0.05$.

RESULTS

Table 1 presents the Pearson correlation coefficients psychopathic traits, risk perceptions, and protective behaviors related with the COVID-19.

Regression Models

Linear regression models with boldness, meanness, and disinhibition as predictors were tested for risk perceptions and protective behaviors associated with the COVID-19 pandemic. The statistics of the models and the standardized coefficients for each predictor are displayed in **Table 2**.

Regarding risk perceptions, increased boldness was associated with reduced estimation of COVID-19 spread relative to flu, reduced perceived risk of becoming infected and reduced COVID-19-related state anxiety. Inversely, an increased disinhibition was significantly associated with increased COVID-19-related state anxiety. No other significant associations were found between psychopathic traits and risk perception measures. Regarding protective behaviors,

boldness was the sole predictor of the frequency of protective behaviors, with increased boldness being associated with a reduced frequency of protective behaviors recommended by the local health department. No other significant associations were observed between psychopathic traits and frequency of protective behaviors.

Mediation Models

For the mediation analysis we analyzed the mediating role of COVID-19 risk perception on the association between psychopathic traits and the frequency of protective behaviors with the constraint that only variables that yielded significant associations in the regression analysis were included. Three 10,000 samples bias-corrected and accelerated bootstrap independent mediation models were tested, each one with COVID-19 spread, risk of becoming infected, or COVID-19-related state anxiety as mediators of the association between boldness and frequency of protective behaviors recommended by the local health department.

Model 1: Boldness, COVID-19 Spread, and Protective Behaviors

The model exploring the role of risk perceptions in *COVID-19 spread* (mediator) on the adoption of *protective behaviors* (outcome), as explained by psychopathic *boldness* traits (predictor) indicated that: (a) *COVID-19 spread* did not predict the frequency of *protective behaviors*, $\beta = 0.001$, $p = 0.757$, and (b) there were no mediation effects as observed by the standardized relative indirect effects, 95% CI $[-0.049;0.052]$.

Model 2: Boldness, Risk of Becoming Infected, and Protective Behaviors

The model exploring the role of *risk perceptions in becoming infected* by SARS-CoV-2 (mediator) on the adoption of *protective behaviors* (outcome), as explained by psychopathic *boldness* traits (predictor) indicated that: (a) the *risk of becoming infected* did not predict the frequency of *protective behaviors*, $\beta = -0.007$, $p = 0.871$, and (b) there were no mediation

TABLE 1 | Pearson correlation coefficients for age, psychopathic traits, risk perceptions and behaviors related to the COVID-19.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Boldness	–											
2. Meanness	0.14	–										
3. Disinhibition	–0.10	0.63*	–									
4. COVID-19 reaction	–0.06	–0.11	–0.13	–								
5. Penalties	–0.05	–0.15*	–0.16*	0.20*	–							
6. COVID-19 spread	–0.25*	–0.09	–0.06	0.12	0.06	–						
7. Risk of infecting others	–0.10	0.06	0.08	–0.03	–0.02	–0.18	–					
8. Risk of becoming infected	–0.14*	0.10	0.10	0.01	0.02	–0.19	0.84*	–				
9. RP on high-risk scenarios	–0.10	0.02	–0.06	0.23*	0.33*	–0.06	0.22*	0.30*	–			
10. RP on low-risk scenarios	–0.06	–0.02	–0.04	0.17*	0.29*	–0.09	0.25*	0.30*	0.80*	–		
11. COVID-19 state anxiety	–0.23*	–0.02*	0.14*	0.12	0.08	0.19	0.11	0.14*	0.26*	0.31*	–	
12. Protective behaviors	–0.15*	–0.10	–0.08	0.21*	0.11	0.05	0.10	0.01	0.19*	0.11	0.13	–

*, significant at $p < 0.05$; RP, Risk Perceptions. Values in bold highlight the significant associations.

TABLE 2 | Regression models with psychopathic traits as predictors of risk perceptions and protective behaviors.

	Model Statistics			Predictors					
	F	AdjR ²	p	Boldness		Meanness		Disinhibition	
				β	p	β	p	β	p
COVID-19 reaction	1.52	0.008	0.210	-0.070	0.347	-0.027	0.778	-0.122	0.205
Penalties	2.03	0.016	0.111	-0.051	0.495	-0.072	0.453	-0.114	0.232
COVID-19 spread	2.50	0.043	0.064	-0.268	0.002*	0.031	0.821	-0.121	0.372
Risk of infecting others	1.00	<0.001	0.393	-0.100	0.182	0.043	0.659	0.042	0.683
Risk of becoming infected	2.32	0.020	0.077	-0.160	0.032*	0.122	0.203	0.001	0.993
RP on high-risk scenarios	1.76	0.012	0.157	-0.132	0.078	0.151	0.117	-0.173	0.072
RP on low-risk scenarios	0.37	0.010	0.776	-0.067	0.376	0.023	0.815	-0.062	0.523
COVID-19 state anxiety	5.27	0.062	0.002*	-0.194	0.008*	-0.125	0.183	0.203	0.030*
Protective behaviors	2.35	0.021	0.074	-0.168	0.025*	-0.008	0.935	-0.097	0.310

*, significant at $p < 0.05$; RP, Risk Perceptions ($df_c, df_e = 3, 190$). Please note that dependent variables are displayed in rows. Values in bold highlight the significant associations.

effects as observed by the standardized relative indirect effects, 95% CI [-0.025;0.029].

Model 3: Boldness, State Anxiety, and Protective Behaviors

The model exploring the role of *COVID-19-related state anxiety* (mediator) on the adoption of *protective behaviors* (outcome), as explained by psychopathic *boldness* traits (predictor) indicated that: (a) state anxiety did not predict the frequency of protective behaviors, $\beta = 0.715$, $p = 0.178$, and (b) there no significant mediation effect of anxiety as observed by the standardized relative indirect effects, 95% CI [-0.065;0.012].

DISCUSSION

The main goal of the present study was to provide an empirical testing of the associations between psychopathic personality traits, perceptions, and behaviors throughout the COVID-19 outbreak. The correlational analysis shows that increased boldness is associated with reduced perception of COVID-19 spread, reduced reported risk of becoming infected, reduced state anxiety, and reduced frequency of protective behaviors. Increased meanness relates with reduced estimated penalties for rule breaking, and increased disinhibition relates with both reduced estimated penalties and increased state anxiety. Importantly, when accounting for the shared variance amongst psychopathic traits, the regression analysis shows the same pattern of associations, with the exception of the associations between both meanness and disinhibition with the estimated penalties, which are not significant in the regression analysis. Additionally, the exploratory mediation analysis shows that risk perceptions related to the COVID-19 are not significant mediators of the associations between boldness and the frequency of protective behaviors.

The study of the influence of personality traits and health related behaviors is suitable for the present context of the COVID-19 pandemic. As stressed by Miguel et al. (2021), although containment measures represent an effective strategy

to reduce the spread of the virus, the individuals' adherence to such measures is influenced by personality characteristics (Carvalho et al., 2020; Miguel et al., 2021), with recent findings suggesting that antisocial and psychopathic traits predict reduced adherence to protective behaviors in response to the pandemic threat (Blagov, 2020; O'Connell et al., 2020). Besides extending the link between psychopathic personality traits and behavioral response to COVID-19 outbreak, this study adds knowledge to the available literature, once it addresses not only how these traits predict COVID-19 outbreak-related perceptions, but also how the latter mediate the association between psychopathic traits and engagement in protective behaviors. In addition, and given that risk perceptions represent a plausible explanatory mechanism for the link between psychopathic traits and patterns of risk-related behaviors (Hosker-Field et al., 2016), the present study further extends our understanding of how psychopathic traits can affect individual reactions to COVID-19 containment measures.

Stemming from the triarchic model of psychopathy, we hypothesized that boldness would be associated with reduced risk perceptions and overall reduced frequency of adopting protective behaviors (H1). Indeed, our results support this hypothesis, given that boldness was associated with reduced estimate of COVID-19 spread, perceived risk of becoming infected, state anxiety toward COVID-19, and frequency of protective behaviors. On this purpose, the well-documented relations between boldness-related traits and both lower physiological sensitivity to threat (Paiva et al., 2020a) and overweighting of reward-related behaviors (Hiatt and Newman, 2006) may provide an explanatory framework for the abovementioned association. The Risk-Return framework of Risky Choice posits that both risk perceptions and perceived benefits are strong determinants of risk-related behaviors (Blais and Weber, 2009). Individuals with high boldness may not only reveal decreased reactivity to the overall COVID-19 threat, leading to lower risk perceptions, but also an overestimation of the benefits (as opposed to risks) of engaging in risky behaviors (e.g., attend to social events, spend time with friends), hindering

the engagement in protective behaviors. Nonetheless, no support was found for the mediating role of risk perceptions in the associations between boldness and the frequency of protective behaviors.

We also hypothesized that meanness would be associated with reduced estimated probability of infecting others and that both meanness and disinhibition would be related to less frequent adoption of protective behaviors (H2 and H3). However, data obtained here do not provide support for such hypotheses, since meanness was neither linked to risk perceptions, nor to the frequency of protective behaviors, and disinhibition was not associated with the frequency of protective behaviors. In fact, the sole significant association was found for disinhibition and increased state anxiety toward COVID-19 outbreak. This association highlights the possible role of state anxiety as a protective factor, favoring the adherence to protective behaviors. In fact, a previous national survey found compelling evidence for the role of anxiety in predicting the adoption of protective measures (Pasion et al., 2020). Specifically, while trait-like anxiety generally predisposes disinhibited individuals to manifest disruptive behavior by reducing the behavioral initiation threshold (Patrick et al., 2009; Paiva et al., 2020b), state anxiety related to the COVID-19 circumstances may prevent risk-taking behaviors in these individuals, as suggested by the results of the regression analysis. Finally, meanness trait entails characteristics of high interpersonal value, such as blunted empathy and lack of close attachment to others (Patrick et al., 2009), sharing trait fearlessness characteristics with boldness along with patterns of externalizing behavior with disinhibition. As we did not control neither empathic concern nor intent to place others at harm (e.g., Blagov, 2020), future studies should explore how these variables affect the association between meanness and protective behaviors, while also considering the role of empathy.

As study limitations, we would like to highlight the sample size ($N = 194$), which prevents a robust generalization to the whole population. Apart from the personality traits studied here, other features may interplay, such as prudence or consciousness, obsessive-compulsive behavior, so that further studies with bigger samples and addressing more personality traits are of extreme usefulness to better represent the whole population. Data collection was carried out during the first COVID-19 outbreak, when uncertainties regarding risks and appropriate behaviors were higher. As so, the scope of the present results is somehow limited to the first pandemic wave, but it may still add value to better understand and prevent public reactions to further COVID-19 waves or new pandemics. Finally, the present work focused on the individual responses to the health control measures imposed in by governmental action to contain the spread of the coronavirus. However, in countries, such as Brazil and even the United States, the government control measures were far less restrictive (e.g., no home confinement nor mask wearing in public spaces mandates). In the present work we did not analyzed the relation between psychopathic traits, perceptions, and behaviors in individuals with government responsibilities. By addressing this issue, future studies may

contribute toward a more comprehensive analysis on how psychopathic traits may affect individual behaviors in distinct roles and contexts.

CONCLUSION

As far as we know, this is the first study addressing the association between psychopathic traits, risk perceptions, and frequency of adopting protective behaviors related to COVID-19 outbreak. In the current context, both individual and collective adherence to health recommendations and spread control measures are essential to minimize the economic and social impact of COVID-19 pandemic. Our results unveil that psychopathic traits, specifically boldness, affect not only risk perceptions, but also the propensity to engage in protective measures (self and others), reducing it. By taking into account that individuals react differently to public health messages as a function of personality traits, the definition of the public health strategy and related dissemination would gain by a better adjustment to individual reactions, and possibly by implementing communication strategies specifically targeting populations with higher psychopathic traits in order to optimize engagement in protective measures.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Local Ethics Committee, Faculty of Psychology and Education Sciences of the University of Porto. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

TP, RP, PA, and FB conceptualized and designed the study. TP and RP collected the data. TP, NC-M, and RP processed and analyzed the data and drafted the manuscript. TP, NC-M, RP, PA, and FB discussed the results and approved the final version of the manuscript. FB and PA reviewed the first draft. All authors contributed to the article and approved the submitted version.

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REFERENCES

- Blagov, P. S. (2020). Adaptive and dark personality in the COVID-19 pandemic: predicting health-behavior endorsement and the appeal of public-health messages. *Soc. Psychol. Pers. Sci.* doi: 10.1177/1948550620936439
- Blair, R. J. R. (2005). Applying a cognitive neuroscience perspective to the disorder of psychopathy. *Dev. Psychopathol.* 17, 865–891. doi: 10.1017/S0954579405050418
- Blais, A.-R., and Weber, E. U. (2009). *The Domain-Specific Risk Taking Scale for Adult Populations: Item Selection and Preliminary Psychometric Properties* (Technical Report TR 2009-203). Ottawa, ON: Defence Research and Development Canada.
- Carvalho, L., de, F., Pianowski, G., and Gonçalves, A. P. (2020). Personality differences and COVID-19: are extroversion and conscientiousness personality traits associated with engagement with containment measures? *Trends Psychiatry Psychother.* 42, 179–184. doi: 10.1590/2237-6089-2020-0029
- Cleckley, H. (1941). *The Mask of Sanity: An Attempt to Reinterpret the So-Called Psychopathic Personality*. St. Louis, MO: Mosby, 298.
- ECDC (2021). *COVID-19 Situation Update Worldwide, as of 14 January 2021*. Solna Municipality: European Centre for Disease Prevention and Control.
- Hall, J. R., Bernat, E. M., and Patrick, C. J. (2007). Externalizing psychopathology and the error-related negativity. *Psychol. Sci.* 18, 326–333. doi: 10.1111/j.1467-9280.2007.01899.x
- Hare, R. D., and Neumann, C. S. (2008). Psychopathy as a clinical and empirical construct. *Annu. Rev. Clin. Psychol.* 4, 217–246. doi: 10.1146/annurev.clinpsy.3.022806.091452
- Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, 2nd Edn. New York, NY: Guilford Press.
- Hiatt, K. D., and Newman, J. P. (2006). “Understanding psychopathy: the cognitive side,” in *Handbook of Psychopathy*, ed. C. J. Patrick (New York, NY: The Guilford Press), 334–352.
- Hosker-Field, A. M., Molnar, D. S., and Book, A. S. (2016). Psychopathy and risk taking: examining the role of risk perception. *Pers. Individ. Differ.* 91, 123–132. doi: 10.1016/j.paid.2015.11.059
- Hudek-Knežević, J., Kardum, I., and Krapčić, N. (2007). HIV-transmission knowledge, five-factor personality traits and psychopathy as determinants of risky sexual behaviors. *Rev. Psychol.* 14, 139–152.
- Khalaf, K., Papp, N., Chou, J. T.-T., Hana, D., Mackiewicz, A., and Kaczmarek, M. (2020). SARS-CoV-2: pathogenesis, and advancements in diagnostics and treatment. *Front. Immunol.* 11:570927. doi: 10.3389/fimmu.2020.570927
- Lanciano, T., Graziano, G., Curci, A., Costadura, S., and Monaco, A. (2020). Risk perceptions and psychological effects during the Italian COVID-19 emergency. *Front. Psychol.* 11:580053. doi: 10.3389/fpsyg.2020.580053
- Mækela, M. J., Reggev, N., Dutra, N., Tamayo, R. M., Silva-Sobrinho, R. A., Klevjer, K., et al. (2020). Perceived efficacy of COVID-19 restrictions, reactions and their impact on mental health during the early phase of the outbreak in six countries. *R. Soc. Open Sci.* 7:200644. doi: 10.1098/rsos.200644
- Miguel, F. K., Machado, G. M., Pianowski, G., Carvalho, L., and de, F. (2021). Compliance with containment measures to the COVID-19 pandemic over time: do antisocial traits matter? *Pers. Individ. Differ.* 168:110346. doi: 10.1016/j.paid.2020.110346
- O’Connell, K., Berluti, K., Rhoads, S. A., and Marsh, A. (2020). Reduced social distancing during the COVID-19 pandemic is associated with antisocial behaviors in an online United States sample. *PsyArXiv* [Preprint]. doi: 10.31234/osf.io/ezyypg
- Pais-Ribeiro, J., Silva, I., Ferreira, T., Martins, A., Meneses, R., and Baltar, M. (2007). Validation study of a Portuguese version of the hospital anxiety and depression scale. *Psychol. Health Med.* 12, 225–237. doi: 10.1080/13548500500524088

SUPPLEMENTARY MATERIAL

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- Paiva, T. O., Almeida, P. R., Coelho, R. C., Pasion, R., Barbosa, F., Ferreira—Santos, F., et al. (2020a). The neurophysiological correlates of the triarchic model of psychopathy: an approach to the basic mechanisms of threat conditioning and inhibitory control. *Psychophysiology* 57:e13567. doi: 10.1111/psyp.13567
- Paiva, T. O., Pasion, R., Patrick, C. J., Moreira, D., Almeida, P. R., and Barbosa, F. (2020b). Further evaluation of the triarchic psychopathy measure: evidence from community adult and prisoner samples from Portugal. *Psychol. Assess.* 32, e1–e14. doi: 10.1037/pas0000797
- Pasion, R., Paiva, T. O., Fernandes, C., and Barbosa, F. (2020). The age effect on protective behaviors during the COVID-19 outbreak: sociodemographic, perceptions and psychological accounts. *Front. Psychol.* 11:561785. doi: 10.3389/fpsyg.2020.561785
- Patrick, C. J. (1994). Emotion and psychopathy: startling new insights. *Psychophysiology* 31, 319–330. doi: 10.1111/j.1469-8986.1994.tb02440.x
- Patrick, C. J. (2010). *Operationalizing the Triarchic Conceptualization of Psychopathy: Preliminary Description of Brief Scales for Assessment of Boldness, Meanness, and Disinhibition*. Tallahassee, FL: Florida State University, 1110–1131.
- Patrick, C. J., and Bernat, E. M. (2010). “Neuroscientific foundations of psychopathology,” in *Contemporary Directions in Psychopathology: Scientific Foundations of the DSM-V and ICD-11*, eds T. Millon, R. F. Krueger, and E. Simonsen (New York, NY: The Guilford Press), 419–452.
- Patrick, C. J., and Drislane, L. E. (2015). Triarchic model of psychopathy: origins, operationalizations, and observed linkages with personality and general psychopathology: triarchic model of psychopathy. *J. Pers.* 83, 627–643. doi: 10.1111/jopy.12119
- Patrick, C. J., Fowles, D. C., and Krueger, R. F. (2009). Triarchic conceptualization of psychopathy: developmental origins of disinhibition, boldness, and meanness. *Dev. Psychopathol.* 21, 913–938. doi: 10.1017/S0954579409000492
- Pfafftheicher, S., Nockur, L., Böhm, R., Sassenrath, C., and Petersen, M. B. (2020). The emotional path to action: empathy promotes physical distancing and wearing of face masks during the COVID-19 pandemic. *Psychol. Sci.* 31, 1363–1373. doi: 10.1177/0956797620964422
- Strickhouser, J. E., Zell, E., and Krizan, Z. (2017). Does personality predict health and well-being? A metasynthesis. *Health Psychol.* 36, 797–810. doi: 10.1037/hea0000475
- Torequul Islam, M., Nasiruddin, Md, Khan, I. N., Mishra, S. K., Kudrat-E-Zahan, Md, Alam Riaz, T., et al. (2020). A perspective on emerging therapeutic interventions for COVID-19. *Front. Public Health* 8:281. doi: 10.3389/fpubh.2020.00281
- Vieira, J., Pierzchajlo, S., Jangard, S., Marsh, A., and Olsson, A. (2020). Perceived threat and acute anxiety predict increased everyday altruism during the COVID-19 pandemic. *PsyArXiv* [Preprint]. doi: 10.31234/osf.io/n3t5c
- Wise, T., Zbozinek, T. D., Michelini, G., Hagan, C. C., and Mobbs, D. (2020). Changes in risk perception and self-reported protective behaviour during the first week of the COVID-19 pandemic in the United States. *R. Soc. Open Sci.* 7:200742. doi: 10.1098/rsos.200742
- Zigmond, A. S., and Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatr. Scand.* 67, 361–370. doi: 10.1111/j.1600-0447.1983.tb09716.x

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Anxiety and Social Support as Predictors of Student Academic Motivation During the COVID-19

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In this study we examined whether parents' perceptions of students' anxiety as well as perceived support from both teachers and classmates were predictive of changes in students' academic motivation during the first wave of COVID-19. To this end, we used a retrospective pretest-posttest design together with a latent change score model to analyze our data. From April to May of 2020, 394 Portuguese parents of students in grades 1–9 participated in this study. Our results showed that students' anxiety and teachers' social support, as perceived by parents, were highly significant predictors of academic motivation changes. Specifically, we found a negative effect of anxiety and a positive effect of teachers' social support on students' academic motivation. Our results did not show, however, a significant predictive role of classmates' social support. This study provides an important contribution to further understand the intrapersonal and interpersonal factors that are associated with the decline of students' academic motivation during the COVID-19 pandemic. The pivotal role of teachers in sustaining students' academic motivation and other relevant educational implications for the ongoing pandemic are discussed.

Keywords: COVID-19, pandemic, students, academic motivation, anxiety, social support, remote learning, parents' perceptions

INTRODUCTION

The disruptive effects of the COVID-19 pandemic have profoundly impacted all sectors of society, including education. Home confinement measures, school closures, and a sudden shift to remote learning imposed substantial changes to teachers, students, and their families' daily lives. According to a United Nations policy brief of August 2020, nearly 1.6 billion students in more than 190 countries from all continents were affected by the COVID-19 (United Nations, 2020).

Parents had to provide close support to their children, acting as home tutors. Teachers had to switch from traditional face-to-face classes to alternative forms of distance education, not only embracing new methods, but also ensuring close support for students and their parents. On top of facing a global health emergency that generates fear and anxiety, students shifted to online learning, which required quick adjustments and affected their daily habits, experiences, and expectations. These changes may have required more self-motivation to learn, in a situation characterized by potential less direct support from teachers and classmates (Aucejo et al., 2020).

A recent study, examining the impact of COVID-19 restrictions, has reported a decline in students' academic motivation both in Portugal and in Italy (Zaccoletti et al., 2020). Yet, little is known about the intrapersonal and interpersonal factors that are associated with this decline. As such, it is important that both researchers and practitioners further study the impact of COVID-19 pandemic on students to find ways to mitigate its negative consequences.

In the present study, we aimed to examine the predictive role of anxiety and social support, from teachers and classmates, in the changes of Portuguese students' academic motivation, as perceived by parents. For this purpose, we surveyed 394 parents by means of an online survey during April and May of 2020. We sampled parents—rather than their children—due to time constraints and ethical reasons surrounding the participation on an online survey.

In the following sections, we will address: (a) research on student academic motivation; (b) the impact of COVID-19 on students' anxiety; (c) the role of perceived social support for students; and (d) an overview of the Portuguese educational context.

Academic Motivation

The study of achievement motivation has a long tradition in Educational Psychology (Murphy and Alexander, 2000; Wigfield and Koenka, 2020). Also, in Cognitive Psychology, since the 2000s researchers have focused on the interplay between motivation and cognition, thus acknowledging that motivational states influence cognitive processing (Markman et al., 2005).

Achievement motivation—also coined as competence motivation—can be defined as the “energization and direction of behavior with regard to effectiveness, ability, sufficiency, or success” (Elliot et al., 2017). A large body of meta-analyses and empirical studies have shown that motivation is a medium to strong predictor of academic achievement (e.g., Guay et al., 2010; Cerasoli et al., 2014; Taylor et al., 2014; Kriegbaum et al., 2018). Moreover, motivation was found to contribute to academic achievement even when cognitive skills were jointly considered (Wigfield and Wentzel, 2007). In light of these findings, researchers designed motivational interventions to enhance students' academic achievement. Overall, these interventions were effective in promoting achievement outcomes in diverse domains such as overall GPA, reading, writing, science, and maths (e.g., Wigfield and Wentzel, 2007; Lazowski and Hulleman, 2016; Camacho et al., 2020). Altogether, prior research underlined the pivotal role of motivation in the school context and the promising effects of motivation interventions.

From a theoretical standpoint, several motivation-related theories have been proposed (e.g., self-determination theory, expectancy-value theory, social cognitive theory, self-theories). Despite the differences, these theories share communalities. One communality is the importance attributed to the social context in shaping students' motivation. Parents can facilitate or undermine the development of motivational resources in their children through their socialization practices (Grolnick et al., 2009). In the same line, school settings directly or indirectly influence students' motivation (Anderman and Gray, 2017) and

classmates influence students' motivation and engagement (Ladd et al., 2009). Interestingly, perceived teacher social support was found to remain a significant predictor of academic motivation even when perceived support from parents and classmates were considered (Wentzel, 2009).

Despite communalities between motivation theories, the self-determination theory seems a particularly useful theory to frame empirical research on academic motivation during the COVID-19. According to the self-determination theory, students' intrinsic motivation depends on the satisfaction of basic psychological needs for competence, autonomy, and relatedness (Wentzel, 2009). Competence refers to the need to perceive mastery in one's pursuits and interactions with the social environment; autonomy refers to the perception of psychological freedom and being a causal agent of one's own life; and relatedness refers to the importance of establishing emotional bonds and being in interaction with other people. Students fulfill these psychological needs and consequently become more intrinsically motivated when teachers and classmates provide authentic, warm and supportive environments (Reeve, 2002; Ryan and Deci, 2020). However, the home confinement and the shift to distance learning methods adopted during the first wave of the COVID-19 may have threatened students' fulfillment of the three basic psychological needs, thereby hindering students' intrinsic motivation for school (Zaccoletti et al., 2020). Recent studies showed indeed a decline in students' academic motivation during the COVID-19 pandemic, with younger students showing a greater decrease in their motivation (Pasion et al., 2020; Zaccoletti et al., 2020). Nevertheless, while examining the role of demographic variables in the trajectory of academic motivation during the COVID-19 pandemic is relevant, understanding the predictive role of intrapersonal and interpersonal variables—such as anxiety and perceived social support—is also important to further understand the impact of COVID-19 on students.

COVID-19 and Students' Anxiety

The COVID-19 outbreak imposed school closures worldwide. Students were forced to move to online learning, with no prediction of returning to face-to-face classes. This emergency situation and the sudden need to change habits and routines (Duan and Zhu, 2020) impacted students' perceptions of safety and preparedness to adapt to new learning methods, thereby leading to increased levels of anxiety and stress (Unger and Meiran, 2020).

Anxiety can be defined as a subjective state of fear and apprehension, thus causing physiological arousal such as rapid heart rate, hyperventilation, and sweating (Eysenck, 1992). Worry and concern refer to the cognitive component of anxiety such as intrusive thoughts and perception of vulnerability (Putwain, 2007). Stress was originally conceived as a state of adaptation to environmental pressures (Selye, 1956), which can have either positive or negative outcomes (Putwain, 2007). Despite the different meanings, researchers sometimes use these constructs interchangeably to refer to a state of unpleasant emotional state (Putwain, 2007).

Anxiety, stress and other unpleasant emotional states are common psychological responses to catastrophes or emergencies,

such as public health emergencies (Rubin and Wessely, 2020). Moreover, these events can be traumatic, leading to a sense of insecurity and triggering anxiety disorders, such as post-traumatic stress disorder. Nonetheless, the characteristics of a catastrophe and an epidemic outbreak are distinct. In an epidemic outbreak such as COVID-19, contrary to what happens in a catastrophe, location, scope, and duration are uncertain, which is more likely to contribute to imbalance and lack of sense of security and control (Li et al., 2020).

Recent research has identified distressing psychological consequences related with the COVID-19 pandemic, such as worry, fear, and anxiety (Cao et al., 2020; Chen et al., 2020). Research has also suggested that, in addition to remote learning, isolation and lack of social contact during the pandemic may have led to an increased sense of fear, stress, anxiety, and even depression (Hiremath et al., 2020).

Overall, students' anxiety has been negatively linked to their academic motivation (Omidvar et al., 2013). Also, the shift to remote and online distance learning has been described as possibly compromising students' motivation (Breneiser et al., 2018). Despite the importance of this evidence, there is limited research on the associations between students' anxiety and their academic motivation during the COVID-19.

The Role of Perceived Social Support for Students

Due to its complexity, academic motivation is influenced not only by intrapersonal factors, but also by the broader social context by which students are surrounded. In fact, students' academic attitudes and behaviors are strongly influenced by key social agents, such as teachers, parents, classmates, and friends (Legault et al., 2006). The positive role of social support in academic motivation has been documented (e.g., Tezci et al., 2015), with prior research suggesting positive associations between students' academic motivation and support received from their parents, teachers, and friends (e.g., Atnafu, 2012; High and Scharp, 2015; Jiang et al., 2015).

Social support can be defined as "the processes of social exchange that contribute to the development of individuals' behavioral patterns, social cognitions, and values" (Farmer and Farmer, 1996, p. 433). It is also described as promoting the motivation needed to achieve success, and to cope effectively with stressful events (Tezci et al., 2015).

The role that significant others may play, and how their support may influence students, can be interpreted considering the cognitive evaluation theory, under the umbrella of self-determination theory (Deci and Ryan, 1985, 2002). According to the cognitive evaluation theory, constructive interpersonal support promotes self-determined motivation. In other words, social contexts and key social agents are crucial to fulfill students' basic psychological needs for autonomy, competence, and relatedness, which will facilitate intrinsic and internalized motivation (Deci and Ryan, 1985, 2002).

Research suggests, for instance, that students' motivation benefits when teachers support their *autonomy* (e.g., Reeve, 2002). Existing studies equally point out that constructive

feedback and information exchange between students and their teachers, parents, classmates, and friends may fulfill their *competence* needs (Ryan et al., 1994). *Relatedness* has also been shown to have a powerful effect on academic motivation (Furrer and Skinner, 2003), and the role of social support in academic motivation has been well established in self-determination theory research. Further, support from teachers, parents, classmates, and friends is described as having a cumulative effect (Green-Demers, 2006).

The role of social support in coping with adversity and emergencies more effectively has also been extensively reported (e.g., Masten, 2001). The establishment of relationships with teachers, family, classmates, friends, and other significant adults characterized by emotional and practical support build students' resilience (Taylor et al., 2010).

Particularly during the pandemic, as physical isolation measures were implemented (e.g., social distancing, home confinement), several social support networks may have been suspended (Taylor et al., 2010). Previous studies have already suggested that social support, as perceived by students, was negatively associated with students' anxiety during the pandemic (Cao et al., 2020; Chen et al., 2020; Ma and Miller, 2020). Importantly, perceiving the existence and availability of sources of social support may have contributed to better cope with anxiety related to COVID-19 (Ma and Miller, 2020).

These findings underline the importance of social support to safeguard both students' academic motivation and psychological health. However, to our knowledge, no study has examined how social support was associated with students' academic motivation specifically during the first wave of the COVID-19 pandemic, while simultaneously considering students' anxiety.

Portuguese Educational Context

The Portuguese education system comprises 12 years of compulsory education, divided into basic education (9 years) and secondary education (3 years). In this study we will focus on students attending basic education, which is divided into three cycles: first cycle (i.e., grades 1–4), second cycle (i.e., grades 5 and 6), and third cycle (i.e., grades 7–9) (EACEA/EURYDICE, 2019).

Similar to what happened around the world, the Portuguese government decreed home confinement during the first wave of COVID-19. This measure implied the closure of schools nationwide from 16th March until the end of the school year (Decree-Law no. 14/2020, 2020). Of note, some families self-isolated on their own initiative since the beginning of March.

Following school closures, teachers had to adopt new strategies to ensure that students had access to instruction, even if remotely. Distance, online learning approaches were therefore privileged, implying an ongoing adaptation process on the part of all students, parents, and teachers. This process uncovered the existence of inequalities in the country (e.g., access to electronic equipment, maintenance of individualized support), which prompted several responses from both central government and local institutions. An example refers to broadcasting educational content on national television (Flores and Gago, 2020). Due to these measures, parental and teacher support became indispensable to support

students' academic motivation. Nonetheless, as suggested by recent research, Portuguese students experienced a decrease in their academic motivation with the onset of COVID-19 (Zaccoletti et al., 2020).

THE PRESENT STUDY

Although much research has been conducted on the impact of COVID-19 on the daily lives of students, there are noteworthy research gaps that warrant further empirical enquiry. First, there is still little research on students' academic motivation during the COVID-19 (Zaccoletti et al., 2020). This is a noteworthy gap since motivation is a strong predictor of key academic skills and ultimately contributes to students' psychological well-being, academic achievement, and school completion (e.g., Guay et al., 2008; Archambault et al., 2009; Lai, 2011; Cerasoli et al., 2014; Kriegbaum et al., 2015; Lazowski and Hulleman, 2016; Zaccoletti et al., 2020). Second, as far as we know, no study to date inspected the predictive role of students' anxiety and perceived social support to changes in academic motivation during the COVID-19 pandemic. Third, a recent systematic review underlined that few studies focused on parents' views on the psychological, educational, academic, physical, and emotional impact of the first home confinement period on students (Cachón-Zagalaz et al., 2020).

Therefore, we addressed these research gaps in the present study. Using parents as informants, we tested whether anxiety and perceived social support from teachers and from classmates were predictive of changes in students' academic motivation during the first wave of the COVID-19. We formulated three hypotheses: We anticipated that more anxious students would experience a greater decrease in their academic motivation (H1); We hypothesized that higher social support from teachers would be associated with a lower decrease in students' academic motivation (H2); Similarly, we expected that higher social support from classmates would be associated with a lower decrease in students' academic motivation (H3).

To accomplish these aims, we surveyed 394 Portuguese parents of children in grades 1–9, who completed an online survey during the first wave of COVID-19. We enrolled parents in our study—rather than their children—due to four reasons. First, the participation of young children in online surveys raises ethical and safety concerns. Second, children as young as 6-years old (i.e., first graders) could not ascertain about their academic motivation, anxiety and perceived social support since they are still learning how to read and write. Third, previous studies have shown that parents are reliable sources of information concerning their children's emotions and behaviors (e.g., Gilger, 1992; Allerhand, 2020; Owens et al., 2020; Saçkes et al., 2016). Fourth, a recent systematic review stressed the need for more research focusing on parents' views, who spent a considerable amount of time with their children during the home confinement period (Cachón-Zagalaz et al., 2020).

MATERIALS AND METHODS

Participants

Three hundred ninety-four Portuguese parents of students in grades 1–9 participated in our study (see **Table 1** for detailed demographic information). Each parent was asked to bear in mind only one child while answering the survey, even if they had more than one eligible child. This sample is part of a larger cross-country sample previously used in Zaccoletti et al.'s (2020) study.

Parents' average age was 41 ($SD = 5.53$). Parents' gender was unevenly distributed as we received mostly answers from mothers ($n = 365$). Regarding the educational level, parents reported 15 average years of instruction (school plus higher education). Concerning their work, 172 parents referred that the pandemic affected their professional situation somehow (e.g., unemployment, lay-off, remote work).

Students' average age was 10.04 ($SD = 2.52$). Students' gender distribution was balanced ($n_{girls} = 191$, $n_{boys} = 203$). As for the grade-level, 50% of the students were in grades 1–4, 34% were in grades 5–6 and 16% were in grades 7–9.

Instruments

Students' Academic Motivation

We used a set of items from the standardized battery AMOS 8–15 (Cornoldi et al., 2005) to assess students' academic motivation. The motivational scale comprised five items, which were scored on a five-point Likert scale, ranging from 1 (I completely disagree) to 5 (I completely agree) (for further details, see Zaccoletti et al., 2020). Two examples of items were: "When the teacher assigns homework, my child does it by self-initiative and not because the parents ask her/him to" and "My child studies the minimum to get a sufficient grade" (reversed item). Higher scores indicated higher intrinsic motivation for school tasks. We used a retrospective pretest–posttest design (Little et al., 2020), thus asking parents to report their perceptions of children's academic

TABLE 1 | Participants' sociodemographic characteristics.

Parents (N = 394)	
Mother	$n = 365$ (92.4%)
Father	$n = 29$ (7.3%)
Age	$M = 41$ ($SD = 5.53$)
Educational level in years	$M = 15$ ($SD = 6.23$)
Professional situation affected by the pandemic	
Yes	$n = 172$ (43.7%)
No	$n = 222$ (56.3%)
Students	
Female	$n = 191$ (48.5%)
Male	$n = 203$ (51.5%)
Age	$M = 10.04$ ($SD = 2.52$)
Grade-level	
Grades 1–4	197 (50%)
Grades 5–6	105 (34%)
Grades 7–9	92 (16%)

motivation in two timepoints: (1) before the onset of COVID-19; (2) during the first wave of the COVID-19. Items were highly reliable at both timepoints (McDonald's $\omega_{pre\ COVID-19} = 0.88$; McDonald's $\omega_{COVID-19} = 0.89$).

Students' Anxiety

We asked parents a single question to measure their perception of children's anxiety during the first wave of COVID-19: "Over the last month, to what extent do you consider that your child felt anxious due to the COVID-19 pandemic?" Parents rated the single item on a 5-point Likert scale, ranging from 1 (Never) to 5 (Always).

Students' Social Support

We used two separate items to assess parents' perceptions of social support provided by teachers and classmates to their children: "Do you think teachers are a source of social support to your child during this period of social isolation?" and "Do you think classmates are a source of social support to your child during this period of social isolation?" Parents rated both items on a 5-point Likert scale, ranging from 1 (Completely false) to 5 (Completely true).

Data Collection

Data collection occurred in April and May of 2020, during the first wave of the COVID-19 pandemic in Portugal. We developed an online survey using Qualtrics XM Platform (Qualtrics, 2019 Provo, UT). The survey was then disseminated to Portuguese parents through: (a) official university channels (i.e., university website, newsletters, and emails); and (b) social media networks (i.e., LinkedIn and Facebook groups). Parents were provided with a detailed consent letter in compliance with the General Data Protection Regulation. Only parents who consented to participate—by checking a box on the online survey—were enrolled in our study. Although we used convenience sampling, we ensured that parents from all Portuguese districts were represented in our sample.

RESULTS

Data Analysis Plan

We used a latent change score model (LCSM; Kievit et al., 2018) to test whether parents' perceptions of students' anxiety, teachers' social support and classmates' social support were predictive of motivation changes, while controlling for the effects of children's age and gender. LCSMs are a class of Structural Equation Models (SEM) that allow testing a wide range of hypotheses about a psychological variable of interest, measured at two time points. LCSM four parameters of interest are the: (1) pre-COVID mean latent motivation score; (2) mean latent change score (i.e., the rate of change in motivation); (3) latent change score variance (i.e., individual variation in the rate of change in motivation); and the (4) covariance between pre-COVID-19 motivation and the mean latent change score (i.e., the dependence of rate of change on initial motivation scores). All measurement model parameters were constrained to be equal

across time (please see Zaccoletti et al., 2020 for further details on the invariance tests). Most relevant for this study is the estimate of the mean latent change score and the estimates of the regression paths linking the predictor variables to this latent score. All predictive variables were grand-mean centered before being included in the model. As such, the motivation change latent score (a latent intercept in SEM terminology), estimated by the LCSM, corresponds to the estimated change in motivation for the average student. All LCSMs were estimated using the lavaan package (version 0.6-5; Rosseel, 2012) in R (version 3.6.1; R Core Team, 2019).

Descriptive Statistics

Table 2 summarizes the descriptive statistics (means, standard deviations, and correlation coefficients) for academic motivation, anxiety, and social support. Correlational analysis showed that (1) all motivation items were negatively and significantly correlated with students' anxiety, with the correlation magnitudes being higher for the COVID-19 period (correlations range: $r_{s_{pre-COVID-19}} = -0.12$ to -0.15 ; $r_{s_{COVID-19}} = -0.13$ to -0.24); (2) except for one item, all other motivation items were positively and significantly correlated with teachers' social support, with the correlation magnitudes, again, being higher for the COVID-19 period (correlations range: $r_{s_{pre-COVID-19}} = 0.09$ to 0.15 ; $r_{s_{COVID-19}} = 0.14$ to 0.20); and (3) only three motivation items, referring to the COVID-19 period, were positively and significantly correlated with classmates' social support, with the correlation magnitudes being lower than for anxiety and teachers' social support.

Latent Change Score Model

The aforementioned correlation patterns are captured in the Latent Change Score Model (LCSM) regression estimates (**Figure 1**; see **Table 3** for complete model estimates). The LCSM estimated a conditional 0.09 non-significant ($p = 0.172$) drop in motivation for the average child (as perceived by their parents), following a pre-COVID-19 mean latent motivation score of 3.10. Higher drops in motivation were significantly associated with higher pre-COVID-19 scores (co-variance = -0.27 , $p < 0.001$). Also, model estimates showed a significant individual variability in the rates of change (latent change score variance = 0.43 , $p < 0.001$).

Concerning our predictor variables, the LCSM also indicated that higher drops in motivation were associated with: (1) higher anxiety scores ($\beta = -0.14$, $SE = 0.04$, $p < 0.001$); (2) lower teacher social support ($\beta = 0.09$, $SE = 0.03$, $p = 0.006$); (3) and younger children ($\beta = 0.06$, $SE = 0.01$, $p < 0.001$). Classmates' social support and gender had no significant effect on motivation change ($ps > 0.05$; see **Table 3** for regression estimates).

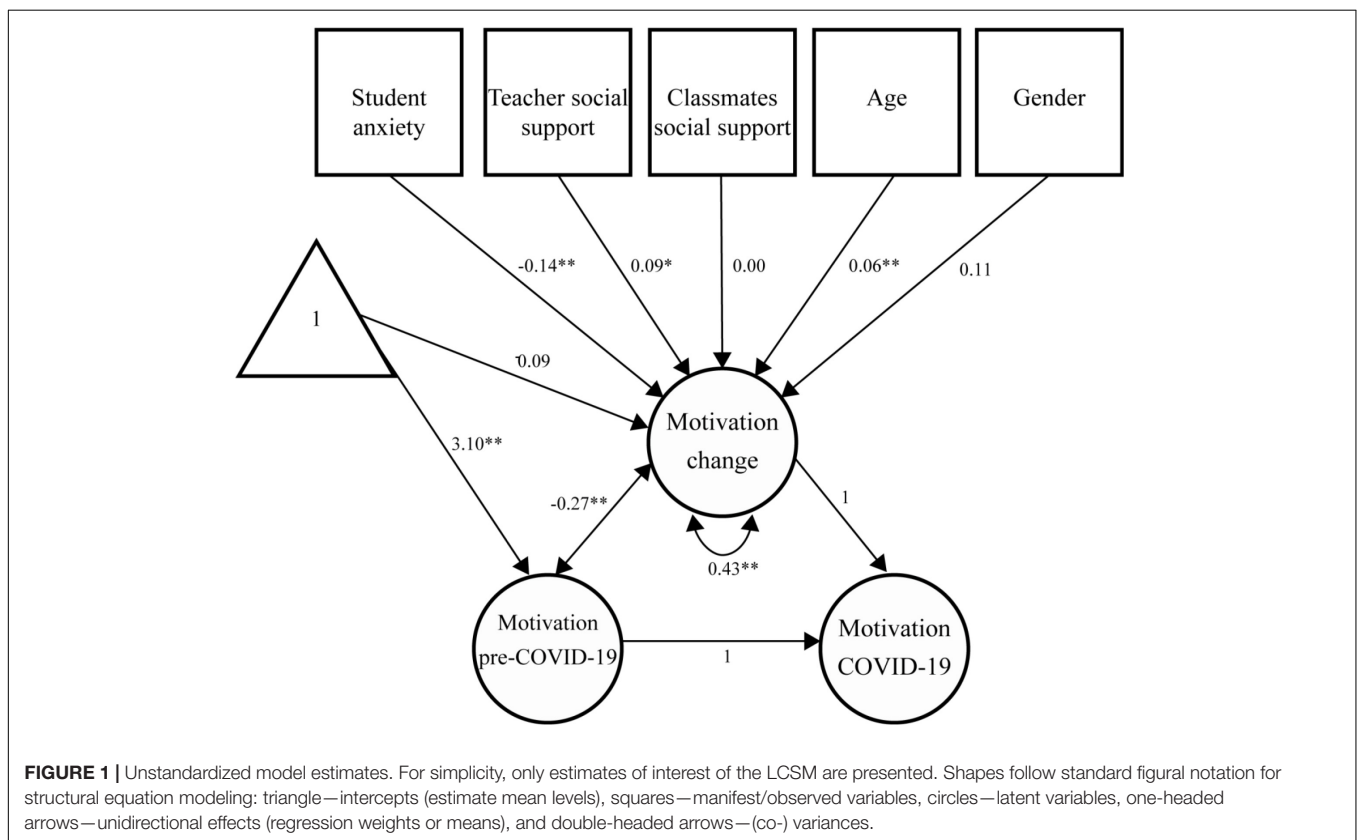
DISCUSSION

In this study, we intended to deepen results obtained in a previous study documenting a decrease in students' academic motivation during the COVID-19, both in Italy and in Portugal (Zaccoletti et al., 2020). Specifically, this study aimed to examine the role of

TABLE 2 | Correlation matrix with Means (*M*) and Standard Deviations (*SD*).

<i>N</i> = 394	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Motivation																
<i>Pre-COVID-19</i>																
M1	3.10	1.24														
M2	3.28	1.22	0.58**													
M3	3.19	1.19	0.61**	0.75**												
M4	3.46	1.23	0.44**	0.54**	0.58**											
M5	3.42	1.15	0.50**	0.69**	0.61**	0.49**										
<i>COVID-19</i>																
M1	3.01	1.25	0.41**	0.48**	0.46**	0.24**	0.42**									
M2	3.21	1.18	0.43**	0.65**	0.60**	0.35**	0.54**	0.73**								
M3	2.99	1.15	0.42**	0.55**	0.66**	0.34**	0.50**	0.70**	0.79**							
M4	3.24	1.17	0.37**	0.46**	0.50**	0.70**	0.41**	0.48**	0.56**	0.58**						
M5	3.26	1.16	0.39**	0.55**	0.47**	0.35**	0.68**	0.57**	0.67**	0.62**	0.48**					
Predictors																
Anxiety	2.88	0.94	-0.12*	-0.13*	-0.15**	-0.10*	-0.12*	-0.24**	-0.20**	-0.23**	-0.20**	-0.13**				
Teachers' social support	3.57	1.18	0.15**	0.13*	0.09	0.14**	0.11*	0.20**	0.18**	0.16**	0.19**	0.14**	-0.00			
Classmates' social support	3.64	1.19	0.04	0.08	0.06	0.05	0.04	0.08	0.12*	0.08	0.11*	0.12*	0.04	0.41**		
Age	10.04	2.52	0.00	0.04	0.11*	-0.10*	0.08	0.09	0.18**	0.20**	0.02	0.18**	0.01	-0.07	0.14**	
Gender	0.52	0.50	0.18**	0.14**	0.11*	0.23**	0.13**	0.09	0.12*	0.13**	0.20**	0.16**	0.04	0.08	-0.10	0.14**

Gender mean values represent the proportion of boys in the sample. Estimates of the LCSM presented in the next table can be reproduced using the correlation matrix **p* < 0.05 and ***p* < 0.01.



students' anxiety and social support (i.e., teachers' social support and classmates' social support) as predictors of the decrease in students' motivation, as perceived by parents. To that end, we

surveyed 394 Portuguese parents of students in grades 1–9 using an online survey distributed from April until May of 2020 (i.e., during the first wave of the COVID-19).

TABLE 3 | Unstandardized latent change score model estimates.

	Estimate	SE	p
1. Regression estimates (Motivation latent change)			
Motivation change ~ Students' anxiety	-0.14	0.04	<0.001
Motivation change ~ Teachers' social support	0.09	0.03	0.006
Motivation change ~ Classmates' social support	0.00	0.04	0.957
Motivation change ~ Age	0.06	0.01	<0.001
Motivation change ~ Gender	0.11	0.07	0.120
2. Factor loadings (Motivation items)			
Motivation pre-COVID-19 = ~ M1	1.00		
Motivation pre-COVID-19 = ~ M2	1.14	0.05	<0.001
Motivation pre-COVID-19 = ~ M3	1.08	0.05	<0.001
Motivation pre-COVID-19 = ~ M4	0.83	0.06	<0.001
Motivation pre-COVID-19 = ~ M5	0.89	0.05	<0.001
Motivation COVID-19 = ~ M1	1.00		
Motivation COVID-19 = ~ M2	1.14	0.05	<0.001
Motivation COVID-19 = ~ M3	1.08	0.05	<0.001
Motivation COVID-19 = ~ M4	0.83	0.06	<0.001
Motivation COVID-19 = ~ M5	0.89	0.05	<0.001
3. Intercepts (means)			
3.1. Motivation items			
M1 pre-COVID-19	0.00		
M2 pre-COVID-19	-0.25	0.16	0.112
M3 pre-COVID-19	-0.17	0.15	0.279
M4 pre-COVID-19	0.89	0.20	<0.001
M5 pre-COVID-19	0.67	0.17	<0.001
M1 COVID-19	0.00		
M2 COVID-19	-0.21	0.15	<0.001
M3 COVID-19	-0.27	0.15	<0.001
M4 COVID-19	0.73	0.19	<0.001
M5 COVID-19	0.59	0.16	<0.001
3.2. Motivation latent variables			
Motivation pre-COVID-19	3.10	0.62	<0.001
Motivation COVID-19	0.00		
Motivation change	-0.09	0.07	0.172
4. Variances			
4.1. Motivation items			
M1 pre-COVID-19	0.82	0.09	<0.001
M2 pre-COVID-19	0.34	0.05	<0.001
M3 pre-COVID-19	0.38	0.05	<0.001
M4 pre-COVID-19	0.91	0.08	<0.001
M5 pre-COVID-19	0.58	0.06	<0.001
M1 COVID-19	0.58	0.07	<0.001
M2 COVID-19	0.25	0.04	<0.001
M3 COVID-19	0.30	0.04	<0.001
M4 COVID-19	0.80	0.07	<0.001
M5 COVID-19	0.63	0.05	<0.001
4.2. Motivation latent change			
Motivation pre-COVID-19	0.00		
Motivation COVID-19	0.86	0.07	<0.001
Motivation change	0.43	0.07	<0.001
5. Co-variances			
Motivation pre-COVID-19 ~ Motivation change	-0.27	0.05	<0.001
6. Correlated error terms			
M1 pre-COVID-19 ~ M1 COVID-19	0.08	0.04	<0.001

(Continued)

TABLE 3 | Continued

	Estimate	SE	p
M2 pre-COVID-19 ~ M2 COVID-19	0.08	0.03	<0.001
M3 pre-COVID-19 ~ M3 COVID-19	0.15	0.03	<0.001
M4 pre-COVID-19 ~ M4 COVID-19	0.60	0.06	<0.001
M5 pre-COVID-19 ~ M5 COVID-19	0.30	0.04	<0.001

"~," "= ~," and "~" symbols follow lavaan R package (Rosseel, 2012) operators' terminology and stand for "regressed on," "is measured by," and "correlated with," respectively.

Our results showed that students' anxiety and teachers' social support, as reported by parents, were significant predictors of the decrease in students' academic motivation during this time. Regarding students' anxiety, we found a negative association between anxiety and academic motivation. Our first hypothesis (H1) was thus confirmed, as more anxious students experienced greater decreases in their academic motivation, based on parents' perceptions. This finding is in line with prior evidence reporting that psychological factors such as anxiety, stress, and grief during emergency situations and quarantines have detrimental effects on learning (Di Pietro et al., 2020). Recent studies examining the impact of COVID-19 on mental health indicators have already shown that students—from primary school to university—experienced a rise in psychological symptoms such as anxiety, stress, and depression (Alemany-Arrebola et al., 2020; Cachón-Zagalaz et al., 2020; Li et al., 2020; Rodríguez-Hidalgo et al., 2020). One of these studies further indicated that university students' anxiety during COVID-19 was negatively related to their academic self-efficacy (Alemany-Arrebola et al., 2020), which is one dimension of academic motivation. In addition, our results concur with research indicating that students' stress and anxiety are negatively associated with their academic motivation (Omidvar et al., 2013).

We also aimed to investigate the predictive role of social support on academic motivation. Based on parents' reports, higher social support from teachers was associated with lower decrease in students' academic motivation, thus confirming our second hypothesis (H2). This finding concurs with previous studies showing that perceived social support from teachers is positively linked to different dimensions of academic motivation (e.g., Wentzel, 1998, 2009; Wentzel et al., 2010; Song et al., 2015). During the first wave of COVID-19, teachers had to master significant challenges. Specifically, they had to adapt to new teaching formats, while maintaining close contact with students and their families, ensuring that students stayed engaged and did not lose their motivation (König et al., 2020). For this reason, during this unprecedented emergency situation, parents may have perceived and valued teachers' crucial role in supporting students' academic motivation.

This finding is consistent with evidence emphasizing that when teachers are involved, provide structure, and establish an autonomy-supportive environment, they contribute to fulfill students' basic psychological needs of relatedness, competence, and autonomy (Deci and Ryan, 1985, 2002; Reeve, 2002; Wentzel, 2009). Basic psychological needs—which are critical

to sustain students' academic motivation—may have been especially compromised during the COVID-19 pandemic (Zaccoletti et al., 2020). The establishment of emotionally close and trusting relationships with teachers is a pathway to develop students' academic motivation and well-being (Wentzel, 2009). Consequently, our findings also stress the importance of collaborative relationships between teachers, students, and parents, particularly during challenging times (Pajarianto et al., 2020).

Unexpectedly, our findings showed that higher classmates' social support was not significantly associated with lower decrease in students' academic motivation, according to parents' perceptions. Therefore, our results failed to support our third hypothesis (H3). One possible explanation for this finding is that we relied on parents' reports rather than on students themselves. Possibly, students could have perceived classmates as a more important source of social support than parents did. In fact, previous studies based on students' perceptions have documented the prominence of classmates as sources of social support, or even similar importance attributed to classmates and teachers (Bokhorst et al., 2010). Specifically, empirical evidence suggests that students tend to rank teachers as most important for providing informational and instrumental support (Lempers and Clark-Lempers, 1992), and to rank classmates as most important for providing informational and emotional support (Reid et al., 1989; Hombrados-Mendieta et al., 2012).

Overall, prior research has demonstrated a positive link between multiple sources of social support and students' behavioral, emotional, and academic adjustment (e.g., Cook et al., 2002). Research has particularly suggested the importance of both teachers and classmates as sources of social support for students (Eccles and Roeser, 2003).

Although our study showed a negative effect of anxiety and a positive effect of teachers' social support on students' academic motivation, our results need to be interpreted with caution since we relied on parents' perceptions. Studies examining the impact of anxiety and sources of social support on academic motivation during the COVID-19 that rely directly on students' perceptions are highly needed.

Limitations and Future Research

This study has some limitations that could stimulate future research. First, data was collected using a convenience sampling method, therefore our sample is not representative of the Portuguese population. Nevertheless, our sample included parents from all Portuguese districts.

Second, we used a retrospective pretest-posttest design (Little et al., 2020), which requires some prudence in making sense of students' academic motivation trajectory, before and after the COVID-19. Particularly, insufficient recall or negatively biased responses due to the unpredictability and constraining situation created by COVID-19 lockdowns might have occurred. Future research, using datasets dating back to pre-COVID-19, might help researchers further explore this trajectory.

Third, in this study we relied on parents as informants, using an online survey and considering one single level of

analysis (i.e., parents' perceptions). In effect, most studies conducted during COVID-19 have used online surveys and self-assessment scales (Saravanan et al., 2020). Also, in relation to the survey, we used single items to operationalize two of our explanatory variables. Although this choice raises concerns, there are several empirical studies, across a range of fields, supporting the use of single items in some cases. For example, for practical reasons (e.g., reduce the length of a survey to avoid more desirable response rates and decrease non-completion rates), or due to a higher predictive power of single items vs. multiple-item scales (e.g., Bergkvist and Rossiter, 2007; Hoepfner et al., 2011; Ahmad et al., 2014; Fisher et al., 2016; Williams and Smith, 2016). Nonetheless, future research might consider multiple informants (e.g., teachers, students), different levels of analysis (e.g., teachers' practices, students' strategies) and complementary methods (e.g., interviews) to achieve a comprehensive understanding of students' academic motivation, its changes, and determinants. Additional research enrolling school-aged samples is highly needed as current empirical publications relating COVID-19 with education are mostly focused on university students. In the same line, studying academic motivation, anxiety, and perceived social support of vulnerable student populations (e.g., students with special needs and students from disadvantaged backgrounds) would be an important research endeavor.

Fourth, we acknowledge that the age span of our sample is large. However, sample size was not sufficient to break it into smaller samples, with robust sample sizes that would allow further analysis of developmental differences.

Fifth, we did not consider students' academic achievement or other psychological outcomes besides students' motivation (e.g., self-regulation), which may be addressed in future research.

Finally, our data was collected in April and May 2020. Thus, we may hypothesize that the magnitude of the association found could differ if data had been collected in March, when face-to-face learning was suspended. In effect, at an earlier stage of the spread of COVID-19 and of the implementation of restrictive measures, students may have been more anxious and psychologically distressed (Saravanan et al., 2020).

Educational Implications

COVID-19 has dramatically changed the daily routines of students, teachers, and parents, who faced increased anxiety and had to adapt to new learning methods. Although our study followed a correlational research design, some educational implications may be discussed. First, both parents and teachers need to be aware and to monitor students' anxiety since it was negatively associated with academic motivation during the first wave of COVID-19. Importantly, parents, teachers, and other educational professionals may equip students with coping strategies to tackle anxiety. This would allow significant adults to promote students' psychological well-being and ultimately their academic motivation.

Second, teachers should be mindful of their role as key sources of social support for students during the COVID-19. For example, even through remote means, teachers can establish a structured, collaborative, and autonomy-supportive classroom

environment, nurturing students' basic psychological needs and academic motivation (Deci and Ryan, 1985; Ryan and Deci, 2000, 2020).

CONCLUSION

Stemming from parents' perceptions, our study contributed to further unveil the impact of COVID-19 on students' academic motivation, shedding light on the predictive role of students' anxiety and teachers' social support. Studying predictors of academic motivation is essential to understand which factors might facilitate or undermine students' trajectories in school, especially during an ongoing pandemic. In this respect, our study highlighted the potential negative role played by COVID-19-related anxiety, that may in turn hamper academic motivation. In addition, this study underlined the potential positive role teachers can have during this pandemic as highly significant sources of social support for students in basic education.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

REFERENCES

- Ahmad, F., Jhaji, A. K., Stewart, D. E., Burghardt, M., and Bierman, A. S. (2014). Single item measures of self-rated mental health: a scoping review. *BMC Health Serv. Res.* 14:398. doi: 10.1186/1472-6963-14-398
- Alemay-Arrebola, I., Rojas-Ruiz, G., Granda-Vera, J., and Mingorance-Estrada, Á.C. (2020). Influence of COVID-19 on the perception of academic self-efficacy, state anxiety, and trait anxiety in college students. *Front. Psychol.* 11:570017. doi: 10.3389/fpsyg.2020.570017
- Allerhand, L. A. (2020). *A Preliminary Investigation into the Construct Validity of the Stanford Social Motivation Scale (SSMS)*. 81. Ann Arbor, MI: ProQuest Information & Learning.
- Anderman, E. M., and Gray, D. L. (2017). "The roles of schools and teachers in fostering competence motivation," in *Handbook of Competence and Motivation: Theory and Application*, eds A. J. Elliot, C. S. Dweck, and D. S. Yeager (New York, NY: The Guilford Press), 604–619.
- Archambault, I., Janosz, M., Morizot, J., and Pagani, L. (2009). Adolescent behavioral, affective, and cognitive engagement in school: relationship to dropout. *J. Sch. Health* 79, 408–415. doi: 10.1111/j.1746-1561.2009.00428.x
- Flores, M., and Gago, M. (2020). Teacher education in times of COVID-19 pandemic in Portugal: national, institutional and pedagogical responses. *J. Educ. Teach.* 46, 507–516. doi: 10.1080/02607476.2020.1799709
- Atnafu, M. (2012). Motivation, social support, alienation from the school and their impact on students' achievement in Mathematics: the case of tenth grade students. *Ethiop. J. Educ. Sci.* 8, 53–74.
- Aucejo, E. M., French, J., Araya, M. P. U., and Zafar, B. (2020). The impact of COVID-19 on student experiences and expectations: evidence from a survey. *J. Public Econom.* 191:104271. doi: 10.1016/j.jpubeco.2020.104271
- Bergkvist, L., and Rossiter, J. R. (2007). The predictive validity of multiple-item versus single-item measures of the same constructs. *J. Mark. Res.* 44, 175–184. doi: 10.1509/jmk.44.2.175
- Bokhorst, C. L., Sumter, S. R., and Westenberg, P. M. (2010). Social support from parents, friends, classmates, and teachers in children and adolescents aged 9 to 18 years: who is perceived as most supportive? *Soc. Dev.* 19, 417–426. doi: 10.1111/j.1467-9507.2009.00540.x

ETHICS STATEMENT

This study was approved by the Ethical Committee for the Psychological Research of the University of Padova (authorization number: 3530). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AC and NC performed conceptualization, methodology, writing original draft, review and editing, and project administration. SZ performed conceptualization, methodology, and review and editing. JD performed data analysis, writing original draft, review and editing. All authors contributed to the article and approved the submitted version.

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- Breneiser, J. E., Rodefer, J. S., and Tost, J. R. (2018). Using tutorial videos to enhance the learning of statistics in an online undergraduate psychology course. *North Am. J. Psychol.* 20, 715–730.
- Cachón-Zagalaz, J., Sánchez-Zafra, M., Sanabrias-Moreno, D., González-Valero, G., Lara-Sánchez, A. J., and Zagalaz-Sánchez, M. L. (2020). Systematic review of the literature about the effects of the COVID-19 pandemic on the lives of school children. *Front. Psychol.* 11:569348. doi: 10.3389/fpsyg.2020.569348
- Camacho, A., Alves, R. A., and Boscolo, P. (2020). Writing motivation in school: a systematic review of empirical research in the early twenty-first century. *Educ. Psychol. Rev.* 2, 1–35. doi: 10.1007/s10648-020-09530-4
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 2020:112934. doi: 10.1016/j.psychres.2020.112934
- Cerasoli, C. P., Nicklin, J. M., and Ford, M. T. (2014). Intrinsic motivation and extrinsic incentives jointly predict performance: a 40-year meta-analysis. *Psychol. Bull.* 140, 980–1008. doi: 10.1037/a0035661
- Chen, Q., Liang, M., Li, Y., Guo, J., Fei, D., Wang, L., et al. (2020). Mental health care for medical staff in China during the COVID-19 outbreak. *Lancet Psychiatry* 7, e15–e16.
- Cook, T. D., Herman, M. R., Phillips, M., Settersten, J., and Richard, A. (2002). Some ways in which neighborhoods, nuclear families, friendship groups, and schools jointly affect changes in early adolescent development. *Child Dev.* 73, 1283–1309. doi: 10.1111/1467-8624.00472
- Cornoldi, C., De Beni, R., Zamperlin, C., and Meneghetti, C. (2005). *AMOS 8-15. Abilità e Motivazione Allo Studio: Prove di Valutazione per Ragazzi Dagli 8 ai 15 Anni. Manuale e protocolli*. Gardolo: Edizioni Erickson.
- Deci, E. L., and Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York, NY: Plenum Press.
- Deci, E. L., and Ryan, R. M. (2002). "Overview of self-determination theory: an organismic dialectical perspective," in *Handbook of Self-Determination Research*, eds E. L. Deci and R. M. Ryan (Rochester, NY: University of Rochester Press), 3–33.
- Decree-Law no. 14/2020 (2020). *Decree-Law no. 14/2020, 86(89)-86(19)*. Available online at: <https://dre.pt/application/conteudo/131393158> (accessed December 15, 2020).

- Di Pietro, G., Biagi, F., Costa, P., Karpinski, Z., and Mazza, J. (2020). *The Likely Impact of COVID-19 on Education: Reflections Based on the Existing Literature and Recent International Datasets. JT Report, Ed.* Luxembourg: Publications Office of the European Union.
- Duan, L., and Zhu, G. (2020). Psychological interventions for people affected by the COVID-19 epidemic. *Lancet Psychiatry* 7, 300–302. doi: 10.1016/S2215-0366(20)30073-0
- EACEA/EURYDICE (2019). *Portugal Overview: Key Features of the Education System.* European Commission. Available online at: https://eacea.ec.europa.eu/national-policies/eurydice/content/portugal_en (accessed December 19, 2020).
- Eccles, J. S., and Roeser, R. W. (2003). "Schools as developmental contexts," in *Blackwell Handbook of Adolescence*, eds G. R. Adams and M. D. Berzonsky (Malden, MA: Blackwell Publishing), 129–148.
- Elliot, A. J., Dweck, C. S., and Yeager, D. S. (2017). *Handbook of Competence and Motivation: Theory and Application.* New York, NY: Guilford Publications.
- Eysenck, M. W. (1992). *Anxiety: The Cognitive Perspective.* Hove: Psychology Press.
- Farmer, T. W., and Farmer, E. M. (1996). Social relationships of students with exceptionalities in mainstream classrooms: social networks and homophily. *Except. Child.* 62, 431–450. doi: 10.1177/001440299606200504
- Fisher, G. G., Matthews, R. A., and Gibbons, A. M. (2016). Developing and investigating the use of single-item measures in organizational research. *J. Occupat. Health Psychol.* 21:3. doi: 10.1037/a0039139
- Furrer, C., and Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *J. Educ. Psychol.* 95, 148–162. doi: 10.1037/0022-0663.95.1.148
- Gilger, J. W. (1992). Using self-report and parental-report survey data to assess past and present academic achievement of adults and children. *J. Appl. Dev. Psychol.* 13, 235–256. doi: 10.1016/0193-3973(92)90031-C
- Green-Demers, I. (2006). "The snowball effect of social support: cumulative influence of teachers, parents, and friends on academic motivation," in *Proceedings of the 7th Annual Conference of the Society for Personality and Social Psychology, Palm Springs, CA, Palm Springs, CA.*
- Grolnick, W. S., Friendly, R. W., and Bellas, V. M. (2009). "Parenting and children's motivation at school," in *Handbook of motivation at school*, eds K. R. Wentzel and A. Wigfield (New York, NY: Routledge/Taylor & Francis Group), 279–300.
- Guay, F., Ratelle, C. F., and Chantal, J. (2008). Optimal learning in optimal contexts: the role of self-determination in education. *Canad. Psychol. Psychol. Canad.* 49, 233–240. doi: 10.1037/a0012758
- Guay, F., Ratelle, C. F., Roy, A., and Litalien, D. (2010). Academic self-concept, autonomous academic motivation, and academic achievement: mediating and additive effects. *Learn. Individ. Differ.* 20, 644–653. doi: 10.1016/j.lindif.2010.08.001
- High, A. C., and Scharp, K. M. (2015). Examining family communication patterns and seeking social support direct and indirect effects through ability and motivation. *Hum. Commun. Res.* 41, 459–479. doi: 10.1111/hcre.12061
- Hiremath, P., Kowshik, C. S., Manjunath, M., and Shettar, M. (2020). COVID 19: impact of lock-down on mental health and tips to overcome. *Asian J. Psychiatry* 51:102088. doi: 10.1016/j.ajp.2020.102088
- Hoepfner, B. B., Kelly, J. F., Urbanoski, K. A., and Slaymaker, V. (2011). Comparative utility of a single-item versus multiple-item measure of self-efficacy in predicting relapse among young adults. *J. Substanc. Abuse Treat.* 41, 305–312. doi: 10.1016/j.jsat.2011.04.005
- Hombrados-Mendieta, M. I., Gomez-Jacinto, L., Dominguez-Fuentes, J. M., Garcia-Leiva, P., and Castro-Travé, M. (2012). Types of social support provided by parents, teachers, and classmates during adolescence. *J. Commun. Psychol.* 40, 645–664. doi: 10.1002/jcop.20523
- Jiang, Y., Bong, M., and Kim, S. I. (2015). Conformity of Korean adolescents in their perceptions of social relationships and academic motivation. *Learn. Individ. Differ.* 40, 41–54. doi: 10.1016/j.lindif.2015.04.012
- Kievit, R. A., Brandmaier, A. M., Ziegler, G., van Harmelen, A.-L., de Mooij, S. M. M., Moutoussis, M., et al. (2018). Developmental cognitive neuroscience using latent change score models: a tutorial and applications. *Dev. Cogn. Neurosci.* 33, 99–117. doi: 10.1016/j.dcn.2017.11.007
- König, J., Jäger-Biela, D. J., and Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *Eur. J. Teach. Educ.* 43, 608–622. doi: 10.1080/02619768.2020.1809650
- Kriegbaum, K., Becker, N., and Spinath, B. (2018). The relative importance of intelligence and motivation as predictors of school achievement: a meta-analysis. *Educational Res. Rev.* 25, 120–148. doi: 10.1016/j.edurev.2018.10.001
- Kriegbaum, K., Jansen, M., and Spinath, B. (2015). Motivation: a predictor of PISA's mathematical competence beyond intelligence and prior test achievement. *Learn. Individ. Differ.* 43, 140–148. doi: 10.1016/j.lindif.2015.08.026
- Ladd, G. W., Herald-Brown, S., and Kochel, K. (2009). "Peers and motivation," in *Handbook of Motivation in School*, eds K. Wentzel, and A. Wigfield. (Mahwah, NJ: Erlbaum), 323–348.
- Lai, E. R. (2011). *Motivation: A Literature Review Research Report. Pearson Research Report.* Available online at http://images.pearsonassessments.com/images/tmrs/Motivation_Review_final.pdf (accessed December 15, 2020).
- Lazowski, R. A., and Hulleman, C. S. (2016). Motivation interventions in education: a meta-analytic review. *Rev. Educ. Res.* 86, 602–640. doi: 10.3102/0034654315617832
- Legault, L., Green-Demers, I., and Pelletier, L. (2006). Why do high school students lack motivation in the classroom? Toward an understanding of academic motivation and the role of social support. *J. Educ. Psychol.* 98, 567–582. doi: 10.1037/0022-0663.98.3.567
- Lempers, J. D., and Clark-Lempers, D. S. (1992). Young, middle, and late adolescents' comparisons of the functional importance of five significant relationships. *J. Youth Adoles.* 21, 53–96. doi: 10.1007/BF01536983
- Li, X., Lv, S., Liu, L., Chen, R., Chen, J., Liang, S., et al. (2020). COVID-19 in Guangdong: immediate perceptions and psychological impact on 304,167 college students. *Front. Psychol.* 11:2024. doi: 10.3389/fpsyg.2020.02024
- Little, T. D., Chang, R., Gorrall, B. K., Waggenspack, L., Fukuda, E., Allen, P. J., et al. (2020). The retrospective pretest-posttest design redux: on its validity as an alternative to traditional pretest-posttest measurement. *Int. J. Behav. Dev.* 44, 175–183. doi: 10.1177/0165025419877973
- Ma, H., and Miller, C. (2020). Trapped in a double bind: chinese overseas student anxiety during the COVID-19 pandemic. *Health Commun.* 2, 1–8. doi: 10.1080/10410236.2020.1775439
- Markman, A. B., Maddox, W. T., and Baldwin, G. C. (2005). The implications of advances in research on motivation for cognitive models. *J. Exp. Theoret. Artif. Intell.* 17, 371–384. doi: 10.1080/09528130500283915
- Masten, A. S. (2001). Ordinary magic: resilience processes in development. *Am. Psychol.* 56, 227–238. doi: 10.1037/0003-066X.56.3.227
- Murphy, P. K., and Alexander, P. A. (2000). A motivated exploration of motivation terminology. *Contemp. Educ. Psychol.* 25, 3–53. doi: 10.1006/ceps.1999.1019
- Omidvar, H., Omidvar, K., and Omidvar, A. (2013). The determination of effectiveness of teaching time management strategies on the mental health and academic motivation of school students. *J. Sch. Psychol.* 2, 6–12.
- Owens, J. S., Allan, D. M., Kassab, H., and Mikami, A. Y. (2020). Evaluating a short form of the academic competence evaluation scales: expanded examination of psychometric properties. *Sch. Mental Health* 12, 38–52. doi: 10.1007/s12310-019-09347-9
- Pajarianto, H., Kadir, A., Galugu, N., Sari, P., and Febrianti, S. (2020). Study from home in the middle of the COVID-19 pandemic: analysis of religiosity, teacher, and parents support against academic stress. *J. Talent Dev. Excel.* 12, 1791–1807.
- Pasion, R., Dias-Oliveira, E., Camacho, A., Morais, C., and Franco, R. C. (2020). Impact of COVID-19 on undergraduate business students: a longitudinal study on academic motivation, engagement, and attachment to university. *Account. Res. J.* [Epub ahead of print].
- Putwain, D. (2007). Researching academic stress and anxiety in students: some methodological considerations. *Br. Educ. Res. J.* 33, 207–219. doi: 10.1080/01411920701208258
- Qualtrics (2019). *Qualtrics.* Provo, UT: Qualtrics.
- R Core Team (2019). *R: A Language and Environment for Statistical Computing.* Vienna: R Foundation for Statistical Computing.
- Reeve, J. (2002). "Self-determination theory applied to educational settings," in *Handbook of Self-Determination Research*, eds E. L. Deci and R. M. Ryan (Rochester, NY: University of Rochester Press), 183–203.
- Reid, M., Landesman, S., Treder, R., and Jaccard, J. (1989). "My family and friends": six- to twelve-year-old children's perceptions of social support. *Child Dev.* 89, 896–910.

- Rodríguez-Hidalgo, A. J., Pantaleón, Y., Dios, I., and Falla, D. (2020). Fear of COVID-19, stress, and anxiety in university undergraduate students: a predictive model for depression. *Front. Psychol.* 11:591797. doi: 10.3389/fpsyg.2020.591797
- Rosseel, Y. (2012). lavaan: an R package for structural equation modeling. *J. Stat. Softw.* 48, 1–36. doi: 10.18637/jss.v048.i02
- Rubin, G. J., and Wessely, S. (2020). The psychological effects of quarantining a city. *BMJ* 368:313. doi: 10.1136/bmj.m313
- Ryan, R. M., and Deci, E. L. (2000). Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemp. Educ. Psychol.* 25, 54–67. doi: 10.1006/ceps.1999.1020
- Ryan, R. M., and Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: definitions, theory, practices, and future directions. *Contemp. Educ. Psychol.* 61:101860. doi: 10.1016/j.cedpsych.2020.101860
- Ryan, R. M., Stiller, J. D., and Lynch, J. H. (1994). Representations of relationships to teachers, parents, and friends as predictors of academic motivation and self-esteem. *J. Early Adoles.* 14, 226–249. doi: 10.1177/027243169401400207
- Saçkes, M., Işitan, S., Avci, K., and Justice, L. M. (2016). Parents' perceptions of children's literacy motivation and their home-literacy practices: what's the connection? *Eur. Early Child. Educ. Res. J.* 24, 857–872. doi: 10.1080/1350293X.2014.996422
- Saravanan, C., Mahmoud, I., Elshami, W., and Taha, M. H. (2020). Knowledge, anxiety, fear, and psychological distress about COVID-19 among university students in the United Arab Emirates. *Front. Psychiatry* 11:582189. doi: 10.3389/fpsyg.2020.582189
- Selye, H. (1956). *The Stress of Life*. New York, NY: Mc Gran-Hill Book Company Inc.
- Song, J., Bong, M., Lee, K., and Kim, S.-i (2015). Longitudinal investigation into the role of perceived social support in adolescents' academic motivation and achievement. *J. Educ. Psychol.* 107, 821–841. doi: 10.1037/edu0000016
- Taylor, G., Jungert, T., Mageau, G. A., Schattke, K., Dedic, H., Rosenfield, S., et al. (2014). A self-determination theory approach to predicting school achievement over time: the unique role of intrinsic motivation. *Contemp. Educ. Psychol.* 39, 342–358. doi: 10.1016/j.cedpsych.2014.08.002
- Taylor, M., Barr, M., Stevens, G., Bryson-Taylor, D., Agho, K., Jacobs, J., et al. (2010). Psychosocial stress and strategies for managing adversity: measuring population resilience in New South Wales, Australia. *Popul. Health Metrics* 8:28.
- Tezci, E., Sezer, F., Gurgan, U., and Aktan, S. (2015). A study on social support and motivation. *Anthropologist* 22, 284–292. doi: 10.1080/09720073.2015.11891879
- Unger, S., and Meiran, W. (2020). Student attitudes towards online education during the COVID-19 viral outbreak of 2020: distance learning in a time of social distance. *Int. J. Technol. Educ. Sci.* 4, 256–266. doi: 10.46328/ijtes.v4i4.107
- United Nations (2020). *Education During COVID-19 and Beyond*. United Nations Sustainable Development Group. Available online at: https://www.un.org/development/desa/dspd/wpcontent/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf (accessed August 22, 2020).
- Wentzel, K. R. (1998). Social relationships and motivation in middle school: the role of parents, teachers, and peers. *J. Educ. Psychol.* 90, 202–209. doi: 10.1037/0022-0663.90.2.202
- Wentzel, K. R. (2009). "Students' relationships with teachers as motivational contexts," in *Handbook of Motivation at School*, eds K. R. Wentzel and A. Wigfield (New York, NY: Routledge/Taylor & Francis Group), 301–322.
- Wentzel, K. R., Battle, A., Russell, S. L., and Looney, L. B. (2010). Social supports from teachers and peers as predictors of academic and social motivation. *Contemp. Educ. Psychol.* 35, 193–202. doi: 10.1016/j.cedpsych.2010.03.002
- Wigfield, A., and Koenka, A. C. (2020). Where do we go from here in academic motivation theory and research? Some reflections and recommendations for future work. *Contemp. Educ. Psychol.* 2020:101872. doi: 10.1016/j.cedpsych.2020.101872
- Wigfield, A., and Wentzel, K. R. (2007). Introduction to motivation at school: interventions that work. *Educ. Psychol.* 42, 191–196. doi: 10.1080/00461520701621038
- Williams, G., and Smith, A. P. (2016). Using single-item measures to examine the relationships between work, personality, and well-being in the workplace. *Psychology* 7, 753–767. doi: 10.4236/psych.2016.76078
- Zaccoletti, S., Camacho, A., Correia, N., Aguiar, C., Mason, L., Alves, R. A., et al. (2020). Parents' perceptions of student academic motivation during the COVID-19 lockdown: a cross-country comparison. *Front. Psychol.* 11:592670. doi: 10.3389/fpsyg.2020.592670

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Who Believes in COVID-19 Conspiracy Theories in Croatia? Prevalence and Predictors of Conspiracy Beliefs

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The COVID-19 pandemic has given rise to numerous new conspiracy theories related to the virus. This study aimed to investigate a range of individual predictors of beliefs in COVID-19 conspiracy theories that account for sociodemographic characteristics (age, gender, education, economic standard, the importance of religion, and political self-identification), distinctive motivational orientations (social dominance and authoritarianism), relevant social attitudes (sense of political powerlessness and trust in science and scientists), and perceived personal risk (perceived risk for self and family members, the concern of being infected, and the expected influence of pandemic on the economic standard of an individual). Participants were 1,060 adults recruited from the general public of Croatia. The sample was a probabilistic quota sample with gender, age, level of education, size of the dwelling, and region of the country as predetermined quotas. The regression model explained 42.2% of the individual differences in beliefs in COVID-19 conspiracy theories. Trust in science and scientists and political powerlessness were the strongest predictors, whereas fear of being infected had the weakest contribution in explaining the variance of the criterion. Additionally, results revealed that the relation of conventionalism (as a proxy of authoritarianism) with belief in COVID-19 conspiracies was mediated by trust in science and scientists. The relation between social dominance and belief in conspiracies was also partially mediated by trust in science. The results suggest that (re)building trust in science and lowering the sense of political helplessness might help in fighting potentially harmful false beliefs about the pandemic.

Keywords: COVID-19 conspiracy theories, trust in science and scientists, political powerlessness, authoritarianism, social dominance

INTRODUCTION

A conspiracy theory (CT) may be understood as an alternative explanation of an important social event that is hidden from the public. It almost always implies that a group of powerful individuals secretly manages events solely for their malevolent interests (Bale, 2007). A tendency to believe in conspiracy theories is considered to be a relatively stable mindset or predisposition related to a variety of other cognitive and personality traits and attitudes (Uscinski et al., 2016). Research has shown that tendency to believe in conspiracy theories is related to lower levels of analytic thinking

and open-mindedness and higher levels of intuitive thinking (Swami et al., 2014; Pennycook et al., 2015, 2020). It is also related to higher levels of paranoid ideation and schizotypy (Darwin et al., 2011), more pronounced Dark Tetrad traits (Machiavellianism, narcissism, psychopathy, and sadism) (March and Springer, 2019; Bowes et al., 2020), lower agreeableness and conscientiousness (Bowes et al., 2020), as well as lower self-esteem (Swami et al., 2011), and higher individual narcissism (Cichocka et al., 2016).

Beliefs in conspiracy theories are sensitive to social contexts (van Prooijen and Douglas, 2018). Conspiracy theories have been a part of human history for a long time and are more likely to emerge during societal crises driven by a motivation to make sense and establish control and understanding over unpredictable events (van Prooijen and Douglas, 2017). Therefore, it is not surprising that the COVID-19 pandemic gave rise to numerous new conspiracy theories related to the virus, some of which were adopted by many people. At the same time, a growing number of scientific studies are testing accumulated knowledge about predictors, correlates, and consequences of believing in conspiracy theories in the context of the COVID-19 pandemic (for a recent review as shown in van Mulukom et al., 2020). In this study, we will focus on variables predominantly related to social and political factors that may be related to conspiracy ideation (Douglas et al., 2019).

A dual-process motivational approach to ideological attitudes argues that the social and general ideological beliefs are organized along two dimensions: authoritarianism and social dominance (Duckitt, 2001). According to this view, authoritarianism and social dominance express different sets of basic social values or motivational goals. These orientations may have different consequences on how people perceive the world they live in, i.e., on a range of social and political attitudes and behaviors (McFarland and Adelson, 1996; Altemeyer, 1998; Duckitt, 2001). According to Altemeyer (1981, 1996), right-wing authoritarianism (RWA) consists of three attitudinal clusters, authoritarian submission, authoritarian aggression, and conventionalism. Thus, individuals with authoritarian personality are inclined to behave as legitimate authorities tell them, adhere to traditional social norms, and believe that people who do not behave as they are told should be punished. Thus, RWA proved to be an important determinant of prejudice. However, recent studies questioned the notion that RWA is a personality dimension and also showed that authoritarian social attitudes are multidimensionally organized (as shown in Duckitt et al., 2010 for an overview). Thus, newer social psychological theories consider the three authoritarianism subscales as distinct (although related) social attitude dimensions that are expressions of the motivational goal of collective security. On the other hand, according to Sidanius and Pratto (1999), social dominance orientation (SDO) focuses on maintaining existing group-based social hierarchies. More specifically, it recognizes individual differences in the endorsement of group-based hierarchies with some groups at the top and other groups below them, which leads to legitimizing myths that provide justification for these intergroup behaviors and perpetuate hierarchy. It also proved to be an important predictor of prejudice and various political

attitudes (McFarland and Adelson, 1996; Sibley et al., 2006). Although these two constructs are weakly correlated, they represent different motivational goals (Duckitt and Sibley, 2009). While social dominance reflects the beliefs of an individual about the extent to which the world is a competitive jungle, authoritarianism reflects beliefs of the world as a dangerous place. Thus, both could be triggered by the COVID-19 pandemic as a threat to either social hierarchy or security (Duckitt and Fisher, 2003; Huang and Liu, 2005).

Previous studies of conspiracy ideation examined the relative role of ideological orientations or beliefs, authoritarianism and social dominance, in explaining the variance of beliefs in conspiracy theories. The relationship between ideological attitudes and conspiracy ideation was confirmed, people with higher levels of authoritarianism (Abalakina-Paap et al., 1999), RWA, and SDO (Swami, 2012; Bruder et al., 2013; Imhoff and Bruder, 2014) were more likely to believe in conspiracy theories. To our knowledge, until recently, there is only one study on COVID-19 conspiracy theories that included measures of both authoritarianism and social dominance. Results indicated that both variables were positively correlated with belief in COVID-19 conspiracy theories (Lobato et al., 2020).

Abalakina-Paap et al. (1999) proposed five types of reasons of why people believe in conspiracy theories: alienation, powerlessness, simplification of the complex world, explanation of their problems, and providing an opportunity for their hostility. Since conspiracy theories typically imply that a group of powerful people stands behind important events and controls the lives of others in secret, individuals who are distrustful of others and authorities may be prone to explanations offered by conspiracy theories. A feeling of alienation is often accompanied by a feeling of powerlessness, and conspiracy theories provide an explanation for individual hardship. Similarly, people who feel they have a disadvantaged position in society can adhere to conspiracy theories as an explanation. Indeed, believing in conspiracies was found to be related to higher levels of anomie and powerlessness (Abalakina-Paap et al., 1999; Bruder et al., 2013) and anomie and lower interpersonal trust (Brotherton et al., 2013). Political powerlessness mediated the relationship between conspiracy beliefs and behavioral intentions in the case of vaccination and climate preserving behaviors (Jolley and Douglas, 2014a,b). The relationship between powerlessness and believing in conspiracies was confirmed in the context of COVID-19 conspiracies (Biddlestone et al., 2020).

Since the official explanation of events that conspiracy theories dominantly focus on (such as vaccination, landing on the moon, chemtrails, etc.) is almost always scientific, belief in such theories should be closely associated with mistrust and negative attitudes toward science. Although this connection might seem straightforward (Hartman et al., 2017), most studies focused on the rejection of a specific scientific field as a potential adverse effect of spreading conspiracy theories. For example, it has been shown that conspiratorial thinking is related to the rejection of climate science (Lewandowsky et al., 2013a,b; van der Linden, 2015). On the other hand, only a few studies examined general trust in science and scientists as a predictor of acceptance of conspiracy theories. In the

context of belief in COVID-19 conspiracy theories, research showed that science skepticism was strongly associated with endorsement and willingness to spread COVID-19 conspiracies (Lobato et al., 2020) and that trust in scientists was negatively related to believing in COVID-19 conspiracies (Constantinou et al., 2020). Furthermore, trust in science had a mediating role in the relationship between conspiracy ideation and willingness to accept prevention guidelines (Plohl and Musil, 2020).

Although trust in science may be highly influenced by contextual factors, such as the current epidemic, some studies indicated that more stable characteristics may also have an influence, e.g., Walter et al. (2001) report SDO to be correlated with feelings of suspicion whereas RWA is correlated with “irrational” beliefs. These feelings and beliefs directly contravene science and trust in it. Hence, it is expected that RWA and SDO might predict conspiracy belief by reducing trust in science. Although, to our knowledge, there are no studies that investigated the role RWA and SDO play in trust in science, we build upon a research study that looked at the relationship between RWA, SDO, and trust in various public institutions in a longitudinal perspective (Castillo et al., 2011). In this study, RWA and SDO showed significant associations with trust in all public institutions (some correlations were positive and some negative), and the longitudinal nature of this study also revealed that some correlations reversed their effects in time due to modifications in the characteristics of the governmental institutions (e.g., elections and change in the political structure). In addition, RWA was more sensitive to the situational changes in threat than SDO (Doty et al., 1991; Duckitt and Fisher, 2003). Although the trust in science in Croatian society is generally high (Prpi, 2011; Šuljok, 2020), in the case of pandemics, trust in science usually declines and is replaced with public skepticism with the passage of time and increasing economic consequences (Bucchi and Saracino, 2020). Thus, we expect that the threat brought by COVID-19 increases perceived competition and danger among those high on RWA and SDO (resulting in reduced trust in science) and that trust in science might have a mediating role in the relationship between RWA and SDO and conspiracy beliefs.

Unlike some other events that conspiracy theories are focused on, the COVID-19 pandemic offers a rare opportunity to examine the role of individual experiences related to the pandemic, such as perceived personal risk, on accepting unfounded beliefs about the virus. The COVID-19 pandemic poses a global threat, both to the economy and health, and comes with a great many unknowns. This makes it a perfect setting for the rise of anxiety levels and the creation of new conspiracy theories. Research has confirmed a positive correlation between anxiety about COVID-19 and the belief that the disease is part of a conspiracy (Sallam et al., 2020) and between personal uncertainty and conspiratorial thinking (Miller, 2020). COVID-19 conspiracy beliefs were positively correlated with COVID-19 risk perception and anxiety about the virus, and the effect of risk perception on COVID-19-specific conspiracy beliefs was fully mediated by anxiety (Šrol et al., 2021). Risk perception was defined not as an individual, but as a general, risk in terms of perceived infectiousness, severity, and dangerousness of COVID-19. However, research has not yet examined the

potential contribution of the perceived personal economic risk of the pandemic on belief in conspiracy theories. Nevertheless, personal risk, in terms of risk to the health or economic status of an individual, might prove to be a positive predictor and explain an additional portion of the variance in conspiracy beliefs over and above more stable social factors described earlier.

Believing in conspiracy theories about COVID-19 has numerous adverse consequences from reduced safeguarding behavior and adherence to protective guidelines to pseudoscientific health practices (van Mulukom et al., 2020). Identifying vulnerable groups who are prone to believing in conspiracy theories is, therefore, of high importance. Finally, the majority of studies on COVID-19 conspiracy theories used convenience samples with a disproportionately higher number of women, young, and more educated participants than in the general population.

This study aimed to simultaneously investigate a range of individual predictors of beliefs in COVID-19 conspiracy theories in the Croatian general population. Predictors can be arranged into four distinct groups: sociodemographic characteristics (age, gender, education, economic standard, the importance of religion, and political self-identification), distinctive motivational orientations (social dominance and authoritarianism), relevant social attitudes (sense of political powerlessness and trust in science and scientists), and perceived personal risk (perceived personal and/or family member vulnerability, the concern of being infected, and the expected influence of pandemic on the economic standard of an individual). We hypothesized that each of these individual attributes significantly contributes to explaining individual differences in belief in COVID-19 conspiracy theories. We expected the importance of religion, social dominance, authoritarianism, powerlessness, perceived risk for self and family members, a concern of being infected, and the influence of pandemic on the economic standard to be positive predictors of beliefs in COVID-19 conspiracy theories, while the level of education, political self-identification, trust in science and scientists were expected to be negative predictors of belief in COVID-19 conspiracy theories. Furthermore, we expected that each group of predictors would have an incremental contribution toward explaining individual differences in belief in COVID-19 conspiracy theories above and beyond preceding predictors. We also expected trust in science and scientists to mediate the relationship between social dominance and belief in conspiracies and the relationship between authoritarianism and belief in conspiracies. The structure of our sample enables us to explore the level of acceptance of various conspiracy theories about COVID-19 in Croatia.

MATERIALS AND METHODS

Participants

Data collection were done as a part of a larger project using an online panel of respondents who were compensated for their time. Participants were compensated for their time and effort by the system of rewarding points developed by the agency that collected the data. The sample was a national probabilistic quota

sample that was two-way stratified: by region and by size of the dwelling. The structure of the total sample corresponded to the structure of the targeted population according to the valid census, including the distribution of age, gender, and, with corrections, education. Participants comprised 1,060 adults recruited from the general population of Croatia. The mean age was $M = 44$ years ($SD = 15.8$; min = 18; max = 74). About 53.1% of participants were women. Regarding education, there were 16.3% of participants with unfinished or finished primary education, 58.9% finished middle education, and 24.8% were highly educated.

Measures

This research is part of a larger project aimed at targeting determinants of the post-corona social recovery of the Croatian society (Čorkalo Biruški et al., 2020), but we will describe only measures relevant for this article. Participants responded to several other measures related to the main goals of the project.

Demographics

Participants were asked about their age, gender, education level, and estimated economic standard compared to other households in Croatia (ranging from 1 = *significantly below average* to 5 = *significantly above average*), the importance of religion (ranging from 1 = *not important at all* to 5 = *extremely important*), and political self-identification (from left to right with an option to declare oneself as having no political identification).

Right-Wing Authoritarianism

Authoritarianism was measured with a very short authoritarianism scale (Bizumic and Duckitt, 2018). This is a 6-item scale with two items representing each of the three content subdimensions: conservatism or authoritarian submission, traditionalism or conventionalism, and authoritarianism or authoritarian aggression. Item example from conventionalism subdimension: *God's laws about abortion, pornography, and marriage must be strictly followed before it is too late*. Responses were given on a 5-point Likert scale (1 = *extremely disagree*; 5 = *extremely agree*). Reliability analysis for the whole scale resulted in Cronbach's α of only 0.48 with very low inter-item correlations except for the correlation of two items representing conventionalism ($r = 0.54$; $p < 0.01$). Therefore, we decided not to use the whole scale in further analyses but only the subscale of conventionalism/traditionalism. Cronbach's α for this subscale was 0.69. We use it further as representing a proxy measure of authoritarianism.

Social Dominance Orientation

Social dominance orientation was measured with the 5-item Group Dominance subscale (adapted from Todosijević, 2013) of the SDO Scale (Pratto et al., 1994). Participants indicated their agreement with statements such as *In getting what your group wants, it is sometimes necessary to use force against other groups* on a 5-point Likert scale (1 = *extremely disagree*; 5 = *extremely agree*). Confirmatory factor analysis (CFA) confirmed good fit for the expected one-factor model ($\chi^2 = 112$; $df = 5$; $p <$

0.001 $RMSEA = 0.14$; $CFI = 0.93$; $TLI = 0.87$) and the obtained Cronbach's α was satisfactory ($\alpha = 0.81$).

Political Powerlessness

Political powerlessness was measured with a 10-item scale by Neal and Groat (1974). The scale was conceptualized as a low expectancy for control over the outcomes of events and is limited to the political and economic aspects (Neal and Groat, 1974). Participants indicated their agreement with statements such as *It is only wishful thinking to believe that one can influence what happens in society at large* on a 5-point Likert scale (1 = *extremely disagree*; 5 = *extremely agree*). Exploratory factor analysis (EFA) suggested a three-factor structure, with six items loading on the first factor, two items loading on the second, and two items loading on the third factor ($\chi^2 = 97.4$; $df = 18$; $p < 0.001$ $RMSEA = 0.7$; $TLI = 0.91$). Items loading on the second and the third factor were the ones that required reverse scoring¹. Since we could not identify any meaningful difference in the content of those items and items loading on the first factor, we decided to keep only items that had sufficient loadings on the first factor. Cronbach's α for the remaining six items was 0.73.

Trust in Science and Scientists

Trust in science and scientists was measured with the Trust in Science and Scientists Inventory (Nadelson et al., 2014), which originally contains 21 items but was shortened for this study to 12 items, based on previously collected data (Peterlin, 2019). Participants indicated their agreement with statements such as *I trust scientists can find solutions to our major technological problems* on a 5-point Likert scale (1 = *extremely disagree*; 5 = *extremely agree*). EFA resulted with two correlated factors and CFA confirmed good fit for the model with one higher-order factor ($\chi^2 = 200.6$; $df = 52$; $p < 0.001$; $RMSEA = 0.05$; $CFI = 0.97$; $TLI = 0.97$). Cronbach's α was satisfactory ($\alpha = 0.88$).

Perceived Personal Risk

The perceived personal risk was measured with four items. Participants were asked whether they belong to the group at a higher risk of getting infected with COVID-19, whether someone from their family belongs to the group at a higher risk of getting infected with COVID-19, how concerned they are about getting COVID-19 in the future (from 0 = *not at all concerned* to 10 = *extremely concerned*) and to rate the expected influence of pandemic on their economic standard in comparison to other citizens of Croatia (from 1 = *much less than on others* to 5 = *much more than on others*).

Beliefs in COVID-19 Conspiracy Theories

Belief in COVID-19 conspiracy theories was measured with an *ad-hoc* scale constructed for the purpose of this study and consisted of 10 items. Participants were asked to indicate their agreement with statements describing common and popular conspiracy theories about COVID-19 such as *The coronavirus pandemic is the result of a large pharmaceutical companies*

¹In the original scale these were items 1, 5, 6, and 8. Running the analyses for the present study with the original powerlessness scale and all items included yielded similar results and led to identical conclusions.

agreement to make money on vaccines. or *The coronavirus spreads faster in the presence of 5G networks*. Responses were given on a 5-point Likert scale (1 = *extremely disagree*; 5 = *extremely agree*). EFA resulted with two correlated factors and CFA confirmed good fit for the model with one higher-order factor ($\chi^2 = 327.3$; $df = 33$; $p < 0.001$; $RMSEA = 0.09$; $CFI = 0.96$; $TLI = 0.94$). Cronbach's α was high ($\alpha = 0.92$).

Procedure

Data were collected from August 24, 2020 to September 7, 2020 with the help of a well-established public opinion research agency using the computer-assisted web interviewing (CAWI) method. The measures of interest were presented in four blocks: (a) demographics, (b) block containing RWA and SDO scales, (c) block containing trust in science and scientists and political powerlessness scales, and (d) block containing questions about perceived personal risk and beliefs in COVID-19 conspiracy theories scale. Participants answered the demographic questions first, while the order of the three remaining blocks was counterbalanced. Furthermore, the order of the scales in each block was randomized except in block (d). It took the participants ~35 min to complete the questionnaires. At the end of the questionnaire, participants were provided with information about resources where they could ask for psychological support and/or help if they felt they needed it.

RESULTS

Before investigating predictors of belief in COVID-19 conspiracy theories, we were interested in the endorsement rate of such theories in our sample. As can be seen in **Table 1** that reports the question wordings and percent of respondents who agree or strongly agree with each CT, the majority of participants agreed with the conspiracy about the real number of infected people being hidden, followed by the theory about laboratory origin of the virus that almost one-half of the participants agreed with. Another four theories were endorsed by more than a third of the participants.

Results showed that the general level of belief in COVID-19 conspiracy theories in our sample was a little below the middle point of the scale ($M = 2.89$; $SD = 0.93$), with 23% of participants having an average score >3.5 , indicating that they strongly agree or agree with conspiracy theories. In comparison to the general sample, participants who (strongly) agree with conspiracy theories have lower estimated economic standards, have lower level of education, showed more importance to religion, and are more likely not to self-identify themselves politically (**Tables 2, 3**).

As already mentioned, we hypothesized that sociodemographic characteristics, distinctive motivational orientations, relevant social attitudes, and perceived personal risk significantly contribute to explaining individual differences in belief in COVID-19 conspiracy theories. Before any analysis, a correlation matrix was checked (**Table 3**). Intercorrelations between predictor variables were not high (the highest correlation was obtained between the importance of religion and the conventionality subscale of authoritarianism; $r = 0.52$), but the majority of predictor variables were correlated

TABLE 1 | COVID-19 conspiracy theories endorsement rates.

Question wording	% of agree or strongly agree responses
The true number of people infected with coronavirus is hidden from the public.	58.58
The coronavirus did not originate from animals but was created by scientists in the laboratory.	45.09
The coronavirus was released with the aim of destroying some of the world's economies.	38.68
World governments are using this pandemic to abolish civil liberties.	36.32
The coronavirus is as serious as the common flu, if not less so.	35.28
The coronavirus pandemic is the result of a large pharmaceutical companies' agreement to make money on vaccines.	34.34
The coronavirus vaccine already exists, but it is currently being kept secret from us.	25.75
The story about the coronavirus was placed in order to implant a chip with a "developed vaccine."	17.83
The Bill and Melinda Gates Foundation is responsible for the creation and spread of the coronavirus.	15.47
The coronavirus spreads faster in the presence of 5G networks.	10.38

TABLE 2 | Some sociodemographic characteristics of participants in a general sample compared to the same characteristics among participants who (strongly) agree with COVID-19 conspiracy theories.

	Frequency in a general sample	% of participants who agree or strongly agree with the CTs
Gender		
Female	563	22.74%
Male	497	23.34%
Education		
Less than elementary school	10	20.00%
Elementary school	163	29.45%
High school	624	23.72%
University	253	17.79%
PhD	10	10.00%
Political self-identification		
Not politically self-identified	492	27.85%
Politically self-identified	568	18.84%
<i>N</i>	1,060	23.00%

with the criterion variable. Importance of religion, social dominance, conventionalism, political powerlessness, and the expected influence of pandemic on the economic standard of an individual were positively correlated with believing in COVID-19 conspiracies, while the level of education, economic standard, political self-identification, and trust in science and scientists were negatively correlated with the criterion variable.

Since we were interested both in the contribution of each predictor to explaining individual differences in belief

TABLE 3 | Correlation matrix and descriptive statistics.

	General sample		Participants who agree or strongly agree with the CTs		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>															
1. Belief in COVID-19 conspiracy theories	2.89	0.93	4.14	0.41	—														
2. Age	44.01	15.76	41.74	14.30	−0.06	—													
3. Gender					0.05	−0.01	—												
4. Education					−0.18**	−0.11**	−0.05	—											
5. Economic standard	2.9	0.75	2.82	0.83	−0.10**	−0.13**	−0.04	0.24**	—										
6. The importance of religion	3.14	1.35	3.43	1.33	0.22**	0.06*	0.07*	−0.12**	−0.06*	—									
7. Political self-identification					−0.23**	0.17**	−0.14**	0.14**	0.10**	−0.06	—								
8. Social dominance	2.28	0.86	2.52	0.98	0.25**	−0.03	−0.14**	−0.09**	<−0.01	0.09**	<0.01	—							
9. Authoritarianism	2.14	0.99	2.29	1.05	0.20**	0.11**	0.03	−0.14**	−0.11**	0.52**	−0.04	0.19**	—						
10. Political powerlessness	3.42	0.69	3.72	0.74	0.32**	0.10**	0.09**	−0.14**	−0.15**	0.07*	−0.10**	0.14**	−0.01	—					
11. Trust in science and scientists	3.24	0.61	2.78	0.54	−0.60**	0.02	−0.04	0.18**	0.11**	−0.19**	0.23**	−0.26**	−0.27**	−0.30**	—				
12. Perceived risk for self	0.26	0.44	0.21	0.41	−0.05	0.42**	<−0.01	−0.11**	−0.13**	0.04	0.13**	−0.03	0.09**	0.04	0.04	—			
13. Perceived risk for family members	0.51	0.50	0.49	0.50	−0.04	−0.18**	0.09**	0.05	0.08*	−0.06	<−0.01	<0.01	−0.07*	−0.02	0.05	−0.17**	—		
14. Concern of being infected	4.78	3.39	4.32	3.76	−0.06	0.18**	0.09**	−0.10**	−0.08**	0.11**	0.06	0.04	0.13**	0.10**	0.01	0.24**	0.10**	—	
15. Expected influence of pandemic on one's economic standard	3.06	0.67	2,95	0.80	0.10**	0.06	0.04	−0.03	−0.20**	0.05	−0.02	−0.10**	0.04	0.06	−0.06*	0.03	−0.02	0.03	

* $p < 0.05$; ** $p < 0.01$.

in COVID-19 conspiracy theories and to explaining the amount of variance of criterion variable accounted for by each group of predictors after controlling predictors from earlier groups, a four-step multiple regression was conducted with belief in COVID-19 conspiracy theories as to the criterion variable. Sociodemographic variables (age, gender, education, economic standard, the importance of religion, and political self-identification) were entered in step one, motivational orientations (social dominance and authoritarianism) were entered in step two, social attitudes (sense of political powerlessness and trust in science and scientists) were entered in step three and perceived personal risk (perceived risk for self and family members, a concern of being infected, and the expected influence of pandemic on the economic standard of an individual) were entered in step four. Variables were entered in order of their stability, so the variables less susceptible to change (i.e., sociodemographic variables and more enduring motivational orientations) were entered before contextual variables. Regression statistics are shown in **Table 4**.

The hierarchical multiple regression revealed that sociodemographic variables entered in step one accounted for 11.5% of the variation in belief in COVID-19 conspiracy theories. Participants with lower education, those to whom religion is more important, and those who are politically non-identified, were more likely to believe in conspiracy theories. Motivational orientations entered in step two explained an additional 5.5% of variation in belief in COVID-19 conspiracy theories and this change was significant [$F_{(2, 1,042)} = 42.54; p < 0.001$]. Participants with higher social dominance and authoritarianism scores were more likely to believe in conspiracies. Adding social attitudes to the regression model in step three explained an additional 24.2% of the variance in a criterion variable. This change was also significant [$F_{(2, 1,040)} = 214.31; p < 0.001$]. While a sense of political powerlessness was a positive predictor of belief in COVID-19 conspiracy theories, trust in science and scientists was a negative predictor. In this step, level of education and authoritarianism were not significant predictors of belief in COVID-19 conspiracy theories any more. Finally, the addition of perceived personal risk to the regression model in step four explained another 1% of the variance in a criterion variable [$F_{(4, 1,036)} = 4.51; p < 0.01$]. Only the concern of being infected and the expected influence of pandemic on the economic standard of an individual were significant predictors of a criterion variable. Those participants that are more concerned about being infected are less prone to believing in conspiracy theories, while those that expect pandemic to have a greater influence on their economic standard are more prone to believing in conspiracy theories. Generally, the most important predictor was trust in science and scientists. Taken together, all predictors accounted for 42.2% of the variance of belief in conspiracy theories.

Finally, we expected trust in science and scientists to mediate the relationship between authoritarianism and belief in COVID-19 conspiracy theories and the relationship between social dominance and belief in conspiracies. Therefore, two mediation analyses were conducted.

The relationship between authoritarianism and belief in COVID-19 conspiracy theories was fully mediated by trust in science and scientists. As **Figure 1** illustrates, the standardized coefficient between authoritarianism and trust in science and scientists was statistically significant ($a = -0.27; p < 0.01$), as was the standardized coefficient between the trust in science and scientists and belief in COVID-19 conspiracy theories ($b = -0.58; p < 0.01$). The standardized direct effect was not significant ($c' = 0.05; p > 0.05$). The standardized indirect effect, however, was significant ($ab = 0.16; p < 0.01$). We tested the significance of this indirect effect using bootstrapping procedures. Unstandardized indirect effects were computed for each of 5,000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2.5th and 97.5th percentiles. The bootstrapped unstandardized indirect effect was 0.15, and the 95% confidence interval ranged from 0.11 to 0.18. Thus, the indirect effect was statistically significant. Participants with higher scores on authoritarianism are less likely to trust science and scientists, thus they are more likely to believe in COVID-19 conspiracy theories.

The relationship between social dominance and belief in COVID-19 conspiracy theories was partially mediated by trust in science and scientists. As can be seen in **Figure 2**, the standardized coefficient between social dominance and trust in science and scientists was statistically significant ($a = -0.30; p < 0.01$), as was the standardized coefficient between trust in science and scientists and belief in COVID-19 conspiracy theories ($b = -0.57; p < 0.01$). The standardized direct effect was also significant ($c' = 0.12; p < 0.01$). The standardized indirect effect was also significant ($ab = 0.17; p < 0.01$). Again, the significance of indirect effect was tested using bootstrapping procedures, following the previously described steps. The bootstrapped unstandardized indirect effect was 0.16, and the 95% confidence interval ranged from 0.12 to 0.20. Thus, the indirect effect was statistically significant. Participants with scores higher on social dominance are less likely to trust science and scientists, so they are more likely to believe in COVID-19 conspiracy theories.

To summarize, the relationship between authoritarianism and the belief in COVID-19 conspiracies was fully mediated by trust in science and scientists, while the relationship between social dominance and belief in conspiracies was partially mediated by trust in science.

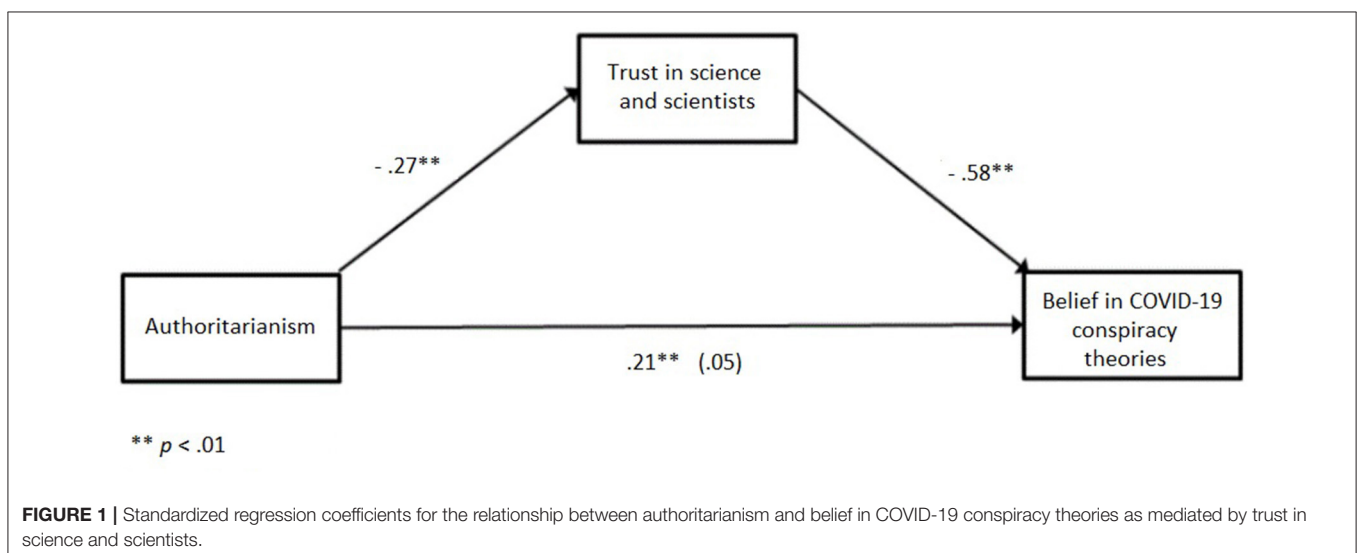
DISCUSSION

The present study aimed to investigate the predictors of believing in COVID-19 conspiracies in the general population of Croatia and to examine the potential influence of experiences with the disease in explaining the additional variance of conspiracist beliefs.

Almost a quarter of the participants had an average score, indicating that they agree or strongly agree with COVID-19 conspiracy theories. The results showed that believing in COVID-19 conspiracies was associated with lower education, lower economic standard, higher importance of religion, and declaring no political self-identification. As expected, we found

TABLE 4 | Summary of hierarchical regression analysis for variables predicting the belief in COVID-19 conspiracy theories.

Variable	Step 1			Step 2			Step 3			Step 4		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Age	<-0.01	<0.01	-0.05	<-0.01	<0.01	-0.05	<-0.01	<0.01	-0.06*	<-0.01	<0.01	-0.05
Gender	-0.01	0.06	-0.01	0.06	0.05	0.03	0.01	0.05	0.01	0.02	0.05	0.01
Education	-0.17	0.04	-0.12**	-0.13	0.04	-0.10**	-0.06	0.04	-0.04	-0.07	0.04	-0.05
Economic standard	-0.06	0.04	-0.05	-0.06	0.04	-0.05	-0.01	0.03	-0.01	0.01	0.03	0.01
The importance of religion	0.13	0.02	0.19**	0.10	0.02	0.14**	0.07	0.02	0.10**	0.07	0.02	0.10**
Political self-identification	-0.35	0.06	-0.19**	-0.36	0.06	-0.19**	-0.16	0.05	-0.09**	-0.15	0.05	-0.08**
Social dominance				0.24	0.03	0.22**	0.10	0.03	0.09**	0.11	0.03	0.11**
Authoritarianism				0.06	0.03	0.07*	<0.01	0.03	<0.01	0.01	0.03	0.01
Political powerlessness							0.20	0.04	0.15**	0.21	0.04	0.15**
Trust in science and scientists							-0.73	0.04	-0.48**	-0.71	0.04	-0.47**
Perceived risk for self										<0.01	0.06	<-0.01
Perceived risk for family members										-0.01	0.05	-0.01
Concern of being infected										-0.02	0.01	-0.08**
Expected influence of pandemic on one's economic standard										0.10	0.03	0.07**
R ²	0.115			0.170			0.412			0.422		
ΔR^2	0.115**			0.055**			0.242**			0.010**		

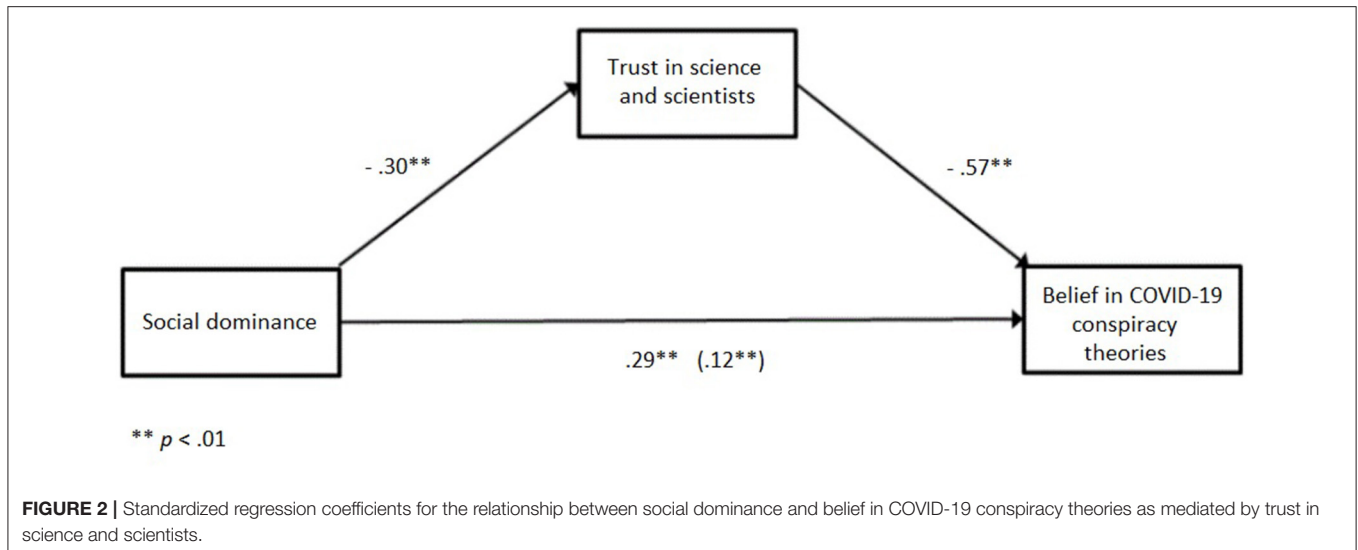
* $p < 0.05$; ** $p < 0.01$.

no differences in believing in conspiracy theories related to COVID-19 based on gender and no relationship with the age of the participants. Results about age and gender differences in believing in COVID-19 conspiracy theories in previous research are mixed with no clear pattern of gender or age differences. Some studies found no gender differences (Earnshaw et al., 2020; Freeman et al., 2020), some found that women are more likely to believe in COVID-19 conspiracy theories (Alper et al., 2020; Erceg et al., 2020; Patsali et al., 2020), while some found that men are more likely to endorse COVID-19 conspiracy theories (Cassese et al., 2020). Similarly, correlation with age was found in studies by Freeman et al. (2020), Constantinou et al. (2020),

Earnshaw et al. (2020), although the correlation differed in sample size.

Regarding education, income, and religiosity, previous research demonstrated relationships in line with lower-income and education levels (Constantinou et al., 2020; Hornik et al., 2021) and a higher level of religiosity (Alper et al., 2020), which were related to a higher endorsement of COVID-19 conspiracy theories.

Since 46.4% of the participants declared not having a political self-identification, we additionally calculated the correlation between political identification and believing in COVID-19 conspiracies on a subsample of participants who did provide



an answer to the question about political orientation on a scale from extremely left/liberal to extremely right/conservative. The analysis showed a positive correlation ($r = 0.14$; $p < 0.001$) in line with a previously obtained positive relationship of conservatism and right-wing ideology with an endorsement of pandemic unrelated conspiracies (Swami, 2012; Pasek et al., 2015; Douglas et al., 2016) and pandemic related conspiracies (Alper et al., 2020; Calvillo et al., 2020; Miller, 2020; Romer and Jamieson, 2020; Uscinski et al., 2020; Farias and Pilati, 2021).

Believing in COVID-19 conspiracy theories was related to a higher result on the SDO scale, higher authoritarianism, higher powerlessness, and lower trust in science and scientists. While other correlations were low or at best moderate in size, correlation with trust in science and scientists is the highest obtained in the study. Trust in science and scientists should be differentiated from science curiosity, science literacy, or scientific reasoning. While the latter represent the ability or willingness to comprehend scientific knowledge, trust in science is more of an attitude toward science and scientists as an authority. Therefore, the observed correlation between trust in science and scientists and believing in conspiracies is expected and fits well in the conspiracy mentality of people who are prone to believe in conspiracy theories. Furthermore, many COVID-19 conspiracies imply that scientists and science are to be blamed for the pandemic (e.g., COVID-19 originated from the science laboratory, COVID-19 vaccine exists but it is kept secret, the real number of infected people is hidden, etc.).

The perceived personal risk was not related to the belief in conspiracies, except for the expected influence of pandemic on the standard of an individual in comparison to others. Participants who expect a higher personal impact from the pandemic believe more in conspiracies.

The regression model explained 42.2% of the individual differences in beliefs in COVID-19 conspiracy theories. Trust in science and scientists and political powerlessness were the strongest predictors, whereas concern of being infected had the

weakest contribution in explaining the variance of the criterion. The importance of religion, social dominance, powerlessness, and expected greater influence of pandemic on the standard of an individual were positive predictors, while political self-identification, trust in science and scientists, and concern about being infected were negative predictors, of believing in COVID-19 conspiracies.

Additionally, results confirmed that the relationship between authoritarianism and belief in COVID-19 conspiracy theories was mediated by trust in science and scientists. The relationship between social dominance and belief in conspiracies was also partially mediated by trust in science. This finding is in line with our expectations and shows that in times of prolonged threat, such as the COVID-19 pandemic, trust in science is declining and being replaced with public skepticism as people face the economic consequences (as suggested by Bucchi and Saracino, 2020). The sense of threat caused by COVID-19 might especially have affected those high on RWA and SDO who perceive those in charge as less trustful and not responding properly to the outside danger. As scientists now hold the key to “normality,” this might have resulted in reduced trust in science, which in turn leads to an increase in endorsing conspiracy beliefs. As RWA proved to be more sensitive to contextual changes than SDO (Doty et al., 1991; Duckitt and Fisher, 2003; Castillo et al., 2011), it comes as no surprise that mediation is stronger in this case.

As previously mentioned, believing in conspiracies is related to numerous adverse behaviors which are particularly undesirable in times of pandemic, such as unwillingness to adhere to protective guidelines (Farias and Pilati, 2021; Karić and Mededović, 2021; Soveri et al., 2021). In line with that, compliance with protective measures is related to a similar set of variables. For example, civic attitudes (Roma et al., 2020) and trust in science and scientists (Dohle et al., 2020; Hromatko et al., 2021) are found to be positively related to adherence to COVID-19 protective measures. However, while some previous research, consistent with this study, show that education is negatively

related to beliefs in conspiracies (Hornik et al., 2021), some other show that education is not a significant predictor (Hromatko et al., 2021; Karić and Mededović, 2021) or is even negatively related to compliance to protective measures (Roma et al., 2020). These results suggest that the relationship of education with belief in conspiracies and adherence to protective measures is not straightforward. It is for further research to unfold this relationship in more detail.

Strengths and Limitations of the Study

The present study has several strengths, including a large national probabilistic sample and the fact that data were collected after the first wave of the pandemic was over in Croatia, but conspiracy theories were on the rise. Future studies should monitor the trajectory of such beliefs, both regarding their content and the extent to which people believe in them, as well as determinants of such beliefs.

Nevertheless, an important limitation of the study is the online panel sample that could have introduced a selection bias, as only those who own a device and are internet users were able to participate as suggested by the low proportion of the uneducated participants in our sample. Nevertheless, as of the beginning of 2019, almost 80% of Croatians aged between 16 and 74 years used the internet (Eurostat, 2020). That being said, it should also be noted that conspiracy theories are dominantly spreading through the internet (Bessi et al., 2015), which additionally justifies using an online panel. Second, this survey was based on self-report instruments, some of which were first used in this study. Even though some were successfully used in previous studies, e.g., the authoritarianism scale (Bizumic and Duckitt, 2018), the reliability of specific subscales proved to be too low, and hence, we used only the conventionalism subscale as the proxy for authoritarianism as it proved to be the most reliable. Moreover, even in the original study, the internal reliability for a 2-item Conventionalism subscale was far higher (i.e., >0.70) than for two other subscales (Bizumic and Duckitt, 2018). There is a plausible expectation that, in times of uncertainty and collective crises, one way of coping with anxiety and distress for some people may be to turn to more dogmatic, authoritarian views and intolerance toward those who oppose “law and order” (e.g., Merolla et al., 2011). Since conventionalism (i.e., traditionalism) precisely reflects a tendency to keep things as they are and to insist on preserving the status quo, which are values at the core of authoritarianism, we used the conventionalism scale as a proxy of authoritarianism. Although we acknowledge a tripartite nature of the authoritarian orientations we have departed from, we also emphasize that conventionalism in itself can increase the belief in conspiracy theories. There is no doubt that the COVID-19 pandemic has caused a threat to our everyday lives. Hence, believing in conspiracy theories may serve as a coping mechanism in dealing with a shaken social order. When a threat arises, those who insist strongly on traditional values and defend their current way of life find it difficult to cope, so a likely coping mechanism may seem to be to believe that “someone” is trying to disturb the order of things and/or destroy traditional values as a part of a “conspiracy” against traditional morality and social values. This finding is also in line with newer socio-psychological

theories of RWA that imply that the three dimensions are distinct (Feldman, 2003; Kreindler, 2005; Jugert and Duckitt, 2009; Duckitt et al., 2010). Some studies already showed that they differentially predict interpersonal behavior, social policy support, and political party support (Duckitt et al., 2010), and the Conventionalism scale proved to be different from the two other dimensions in some previous studies as well (Feldman, 2003; Stenner, 2005). Therefore, our result might complement these findings and imply that conceptualizing authoritarianism as a set of three related, but distinct, ideological attitude dimensions may be more applicable for explaining complex socio-political phenomena than the unidimensional model. Nevertheless, it is theoretically sound to expect that two other dimensions of the RWA syndrome, i.e., authoritarian submission and authoritarian aggression, may also be predictive for believing in CT. These topics are for future studies to explore these relationships more thoroughly.

Conspiracy theories are an ever-existing part of society, but possible ways of fighting against them are still not clear. Results of the study revealed a strong relationship between trust in science and scientists and belief in conspiracy theories and a sense of political powerlessness and belief in conspiracies. Although the correlational nature of this study prevents us from making any causal claims, results suggest that (re)building trust in science and scientists and lowering the sense of political helplessness might help to fight any potentially harmful false beliefs about the pandemic. This path might be especially important for people with high scores in authoritarianism and those with high scores in social dominance. Finally, this study highlights that a personal experience is not highly important for succumbing to irrational beliefs, as proven with a weak contribution of perceived personal risk in explaining CT beliefs.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: The dataset generated for this study can be found in the CROSSDA (Croatian Social Science Data Archive) <https://doi.org/10.23669/CLYQHG>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Department of Psychology, Faculty of Humanities and Social Sciences, University of Zagreb. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MT, FD, MJ, and DČ contributed to conception and design of the study. FD organized the database. MT and FD performed the statistical analysis. MT

wrote the first draft of the manuscript. MJ, FD, and DČ wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

REFERENCES

- Abalakina-Paap, M., Stephan, W. G., Craig, T., and Gregory, W. L. (1999). Beliefs in conspiracies. *Polit. Psychol.* 20, 637–647. doi: 10.1111/0162-895X.00160
- Alper, S., Bayrak, F., and Yilmaz, O. (2020). Psychological correlates of COVID-19 conspiracy beliefs and preventive measures: evidence from turkey. *Curr. Psychol.* doi: 10.1007/s12144-020-00903-0. [Epub ahead of print].
- Altemeyer, B. (1981). *Right-Wing Authoritarianism*. Winnipeg, ON: University of Manitoba Press.
- Altemeyer, B. (1996). *The Authoritarian Specter*. Cambridge, MA: Harvard University Press.
- Altemeyer, B. (1998). The other “authoritarian personality.” *Adv. Exp. Soc. Psychol.* 30, 41–92. doi: 10.1016/S0065-2601(08)60382-2
- Bale, J. M. (2007). Political paranoia v. political realism: on distinguishing between bogus conspiracy theories and genuine conspiratorial politics. *Patterns Prejudice* 41, 45–60. doi: 10.1080/00313220601118751
- Bessi, A., Zollo, F., Del Vicario, M., Scala, A., Caldarelli, G., and Quattrociocchi, W. (2015). Trend of narratives in the age of misinformation. *PLoS ONE* 10:e0134641. doi: 10.1371/journal.pone.0134641
- Biddlestone, M., Green, R., and Douglas, K. (2020). Cultural orientation, power, belief in conspiracy theories, and intentions to reduce the spread of COVID-19. *Br. J. Soc. Psychol.* 59, 663–673. doi: 10.1111/bjso.12397
- Bizumic, B., and Duckitt, J. (2018). Investigating right wing authoritarianism with a very short authoritarianism scale. *J. Soc. Politic. Psychol.* 6, 129–150. doi: 10.5964/jsp.p.v6i1.835
- Bowes, S., Costello, T. H., and Ma, W. (2020). Looking under the Tinfoil Hat: clarifying the personological and psychopathological correlates of conspiracy beliefs. *J. Pers.* doi: 10.31234/osf.io/9pv38. [Epub ahead of print].
- Brotherton, R., French, C. C., and Pickering, A. D. (2013). Measuring belief in conspiracy theories: the generic conspiracist beliefs scale. *Front. Psychol.* 4:279. doi: 10.3389/fpsyg.2013.00279
- Bruder, M., Haffke, P., Neave, N., Nouripanah, N., and Imhoff, R. (2013). Measuring individual differences in generic beliefs in conspiracy theories across cultures: conspiracy mentality questionnaire. *Front. Psychol.* 4:225. doi: 10.3389/fpsyg.2013.00225
- Bucchi, M., and Saracino, B. (2020). *Scared, Supportive and Confident in Science (but a little confused by expert communication). Trends and Changes in the Perception of the Pandemic: The New Data From the Science in Society Monitor*. Available online at: <https://sagepub.blogspot.com/2020/04/italian-citizens-and-covid-19-one-month.html> (accessed December 10, 2020).
- Calvillo, D. P., Ross, B. J., Garcia, R. J., Smelter, T. J., and Rutchick, A. M. (2020). Political ideology predicts perceptions of the threat of covid-19 (and susceptibility to fake news about it). *Soc. Psychol. Personal. Sci.* 11, 1119–1128. doi: 10.1177/1948550620940539
- Cassese, E. C., Farhart, C. E., and Miller, J. M. (2020). Gender differences in COVID-19 conspiracy theory beliefs. *Polit. Gender* 16, 1009–1018. doi: 10.1017/S1743923X20000409
- Castillo, J. C., Miranda, D., and Torres, P. (2011). “Authoritarianism, social dominance and trust in public institutions,” in *Annual Scientific Meeting of the International Society of Political Psychology* (Istanbul). doi: 10.1037/e514882012-001
- Cichocka, A., Marchlewska, M., and De Zavala, A. G. (2016). Does self-love or self-hate predict conspiracy beliefs? Narcissism, self-esteem, and the endorsement of conspiracy theories. *Soc. Psychol. Personal. Sci.* 7, 157–166. doi: 10.1177/1948550615616170
- Constantinou, M., Kagialis, A., and Karekla, M. (2020). COVID-19 scientific facts vs. conspiracy theories: 0–1: science fails to convince even highly educated individuals. *Res. Square*. doi: 10.21203/rs.3.rs-33972/v1. [Epub ahead of print].
- Čorkalo Biruški, D., Jelić, M., Kapović, I., Baketa, N., Bovan, K., Dumančić, F., et al. (2020). *Preživjeti i živjeti: Hrvatsko društvo u vrijeme koronakrize [To survive and live: Croatian society during the corona crisis]*. Zagreb: Friedrich Ebert Stiftung.
- Darwin, H., Neave, N., and Holmes, J. (2011). Belief in conspiracy theories: the role of paranormal belief, paranoid ideation and schizotypy. *Personal. Individ. Differ.* 50, 1289–1293. doi: 10.1016/j.paid.2011.02.027
- Dohle, S., Wingen, T., and Schreiber, M. (2020). Acceptance and adoption of protective measures during the COVID-19 pandemic: the role of trust in politics and trust in science. *Soc. Psychol. Bull.* 15, 1–23. doi: 10.32872/spb.4315
- Doty, R. M., Peterson, B. E., and Winter, D. G. (1991). Threat and authoritarianism in the United States, 1978–1987. *J. Pers. Soc. Psychol.* 61, 629–640. doi: 10.1037/0022-3514.61.4.629
- Douglas, K. M., Sutton, R. M., Callan, M. J., Dawtry, R. J., and Harvey, A. J. (2016). Someone is pulling the strings: hypersensitive agency detection and belief in conspiracy theories. *Think. Reason.* 22, 57–77. doi: 10.1080/13546783.2015.1051586
- Douglas, K. M., Uscinski, J. E., Sutton, R. M., Cichocka, A., Nefes, T., Ang, C. S., et al. (2019). Understanding conspiracy theories. *Polit. Psychol.* 40, 3–35. doi: 10.1111/pops.12568
- Duckitt, J. (2001). “A dual-process cognitive-motivational theory of ideology and prejudice,” in *Advances in Experimental Social Psychology*, Vol. 33, ed M. P. Zanna (San Diego, CA: Academic Press), 41–113. doi: 10.1016/S0065-2601(01)80004-6
- Duckitt, J., Bizumic, B., Krauss, S. W., and Heled, E. (2010). A tripartite approach to right-wing authoritarianism: the authoritarianism-conservatism-traditionalism model. *Polit. Psychol.* 31, 685–715. doi: 10.1111/j.1467-9221.2010.00781.x
- Duckitt, J., and Fisher, K. (2003). The impact of social threat on worldview and ideological attitudes. *Polit. Psychol.* 24, 199–222. doi: 10.1111/0162-895X.00322
- Duckitt, J., and Sibley, C. G. (2009). A dual-process motivational model of ideology, politics, and prejudice. *Psychol. Inq.* 20, 98–109. doi: 10.1080/10478400903028540
- Earnshaw, V. A., Eaton, L. A., Kalichman, S. C., Brousseau, N. M., Hill, E. C., and Fox, A. B. (2020). COVID-19 conspiracy beliefs, health behaviors, and policy support. *Transl. Behav. Med.* 10, 850–856. doi: 10.1093/tbm/ibaa090
- Erceg, N., Ružojić, M., and Galić, Z. (2020). Misbehaving in the corona crisis: the role of anxiety and unfounded beliefs. *Curr. Psychol.* doi: 10.1007/s12144-020-01040-4. [Epub ahead of print].
- Eurostat (2020). *Statistics Explained*. Available online at: <https://ec.europa.eu/eurostat/statisticsexplained/> (accessed December 10, 2020).
- Farias, J. E. M., and Pilati, R. (2021). COVID-19 as an undesirable political issue: conspiracy beliefs and intolerance of uncertainty predict adherence to prevention measures. *Curr. Psychol.* doi: 10.1007/s12144-021-01416-0. [Epub ahead of print].
- Feldman, S. (2003). Enforcing social conformity: a theory of authoritarianism. *Polit. Psychol.* 24, 41–74. doi: 10.1111/0162-895X.00316
- Freeman, D., Waite, F., Rosebrock, L., Petit, A., Causier, C., East, A., et al. (2020). Coronavirus conspiracy beliefs, mistrust, and compliance with government guidelines in England. *Psychol. Med.* doi: 10.1017/S0033291720001890. [Epub ahead of print].
- Hartman, R. O., Dieckmann, N. F., Sprenger, A. M., Stastny, B. J., and DeMarree, K. G. (2017). Modeling attitudes toward science: development and validation of the credibility of science scale. *Basic Appl. Soc. Psych.* 39, 358–371. doi: 10.1080/01973533.2017.1372284
- Hornik, R., Kikut, A., Jesch, E., Woko, C., Siegel, L., and Kim, K. (2021). Association of COVID-19 misinformation with face mask wearing and social distancing in a nationally representative US Sample. *Health Commun.* 36, 6–14. doi: 10.1080/10410236.2020.1847437

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- Hromatko, I., Tonković, M., and Vranic, A. (2021). Trust in science, perceived vulnerability to disease, and adherence to pharmacological and non-pharmacological COVID-19 recommendations. *Front. Psychol.* 12:664554. doi: 10.3389/fpsyg.2021.664554
- Huang, L. L., and Liu, J. (2005). Personality and social structural implications of the situational priming of social dominance orientation. *Pers. Individ. Dif.* 38, 267–276. doi: 10.1016/j.paid.2004.04.006
- Imhoff, R., and Bruder, M. (2014). Speaking (un-)truth to power: conspiracy mentality as a generalised political attitude. *Eur. J. Pers.* 28, 25–43. doi: 10.1002/per.1930
- Jolley, D., and Douglas, K. M. (2014a). The social consequences of conspiracism: exposure to conspiracy theories decreases intentions to engage in politics and to reduce one's carbon footprint. *Br. J. Psychol.* 105, 35–56. doi: 10.1111/bjop.12018
- Jolley, D., and Douglas, K. M. (2014b). The effects of anti-vaccine conspiracy theories on vaccination intentions. *PLoS ONE* 9:e89177. doi: 10.1371/journal.pone.0089177
- Jugert, P., and Duckitt, J. (2009). A motivational model of authoritarianism: integrating personal and situational determinants. *Polit. Psychol.* 30, 693–719. doi: 10.1111/j.1467-9221.2009.00722.x
- Karić, T., and Mededović, J. (2021). Covid-19 conspiracy beliefs and containment-related behaviour: the role of political trust. *Pers. Individ. Dif.* 175:110697. doi: 10.1016/j.paid.2021.110697
- Kreindler, S. (2005). A dual group processes model of individual differences in prejudice. *Personal. Soc. Psychol. Rev.* 9, 90–107. doi: 10.1207/s15327957pspr0902_1
- Lewandowsky, S., Gignac, G. E., and Oberauer, K. (2013a). The role of conspiracist ideation and worldviews in predicting rejection of science. *PLoS ONE* 8:e75637. doi: 10.1371/journal.pone.0075637
- Lewandowsky, S., Oberauer, K., and Gignac, G. E. (2013b). NASA faked the moon landing—therefore, (climate) science is a hoax: an anatomy of the motivated rejection of science. *Psychol. Sci.* 24, 622–633. doi: 10.1177/0956797612457686
- Lobato, E. J. C., Powell, M., Padilla, L., and Holbrook, C. (2020). Factors predicting willingness to share COVID-19 misinformation. *Front. Psychol.* 11:566108. doi: 10.3389/fpsyg.2020.566108
- March, E., and Springer, J. (2019). Belief in conspiracy theories: The predictive role of schizotypy, Machiavellianism, and primary psychopathy. *PLoS ONE* 14:e0225964. doi: 10.1371/journal.pone.0225964
- McFarland, S., and Adelson, S. (1996). “An omnibus study of personality and prejudice,” in *Annual Scientific Meeting of the International Society of Political Psychology*. Vancouver, BC.
- Merolla, J. L., Ramos, J. M., and Zechmeister, E. J. (2011). “Authoritarianism, need for closure, and conditions of threat,” in *Extremism and the Psychology of Uncertainty*, eds M. Hogg and D. L. Blaylock (Wiley-Blackwell), 212–227. doi: 10.1002/9781444344073.ch13
- Miller, J. M. (2020). Psychological, political, and situational factors combine to boost COVID-19 conspiracy theory beliefs. *Canad. J. Politic. Sci.* 53, 327–334. doi: 10.1017/S000842392000058X
- Nadelson, L., Jorczyk, C., Yang, D., Jarratt Smith, M., Matson, S., Cornell, K., et al. (2014). I just don't trust them: the development and validation of an assessment instrument to measure trust in science and scientists. *Sch. Sci. Math.* 114, 76–86. doi: 10.1111/ssm.12051
- Neal, A. G., and Groat, H. T. (1974). Social class correlates of stability and change in levels of alienation: a longitudinal study. *Sociol. Quart.* 15, 548–558. doi: 10.1111/j.1533-8525.1974.tb00914.x
- Pasek, J., Stark, T. H., Krosnick, J. A., and Tompson, T. (2015). What motivates a conspiracy theory? Birther beliefs, partisanship, liberal-conservative ideology, and anti-black attitudes. *Electoral Stud.* 40, 482–489. doi: 10.1016/j.electstud.2014.09.009
- Patsali, M. E., Mousa, D.-P. V., Papadopoulou, E. V., Papadopoulou, K. K., Kaparounaki, C. K., Diakogiannis, I., et al. (2020). University students' changes in mental health status and determinants of behavior during the COVID-19 lockdown in Greece. *Psychiatry Res.* 292:113298. doi: 10.1016/j.psychres.2020.113298
- Pennycook, G., Cheyne, J. A., Koehler, D. J., and Fugelsang, J. A. (2020). On the belief that beliefs should change according to evidence: Implications for conspiratorial, moral, paranormal, political, religious, and science beliefs. *Judgm. Decis. Mak.* 15:476. doi: 10.31234/osf.io/a7k96
- Pennycook, G., Fugelsang, J. A., and Koehler, D. J. (2015). Everyday consequences of analytic thinking. *Curr. Dir. Psychol. Sci.* 24, 425–432. doi: 10.1177/0963721415604610
- Peterlin, M. (2019). *Predictors of trust in science and scientists (Unpublished master's thesis)*. Faculty of Humanities and Social Sciences, University of Zagreb, Croatia.
- Plohl, N., and Musil, B. (2020). Modeling compliance with COVID-19 prevention guidelines: the critical role of trust in science. *Psychol. Health Med.* 26, 1–12. doi: 10.1080/13548506.2020.1772988
- Pratto, F., Sidanius, J., Stallworth, L. M., and Malle, B. F. (1994). Social dominance orientation: a personality variable predicting social and political attitudes. *J. Pers. Soc. Psychol.* 67, 741–763. doi: 10.1037/0022-3514.67.4.741
- Pripić, K. (2011). Science, the public, and social elites: how the general public, scientists, top politicians and managers perceive science. *Public Understanding Sci.* 20, 733–750. doi: 10.1177/0963662510366363
- Roma, P., Monaro, M., Muzi, L., Colasanti, M., Ricci, E., Biondi, S., et al. (2020). How to improve compliance with protective health measures during the COVID-19 outbreak: testing a moderated mediation model and machine learning algorithms. *Int. J. Environ. Res. Public Health* 17:7252. doi: 10.3390/ijerph17197252
- Romer, D., and Jamieson, K. H. (2020). Conspiracy theories as barriers to controlling the spread of COVID-19 in the US. *Soc. Sci. Med.* 263:113356. doi: 10.1016/j.socscimed.2020.113356
- Sallam, M., Dababseh, D., Yaseen, A., Al-Haidar, A., Ababneh, N. A., Bakri, F. G., et al. (2020). Conspiracy beliefs are associated with lower knowledge and higher anxiety levels regarding COVID-19 among students at the University of Jordan. *Int. J. Environ. Res. Public Health* 17:4915. doi: 10.3390/ijerph17144915
- Sibley, C. G., Robertson, A., and Wilson, M. S. (2006). Social dominance orientation and right-wing authoritarianism: additive and interactive effects. *Polit. Psychol.* 27, 755–768. doi: 10.1111/j.1467-9221.2006.00531.x
- Sidanius, J., and Pratto, F. (1999). *Social Dominance: An Intergroup Theory of Social Hierarchy and Oppression*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9781139175043
- Soveri, A., Karlsson, L. C., Antfolk, J., Lindfelt, M., and Lewandowsky, S. (2021). Unwillingness to engage in behaviors that protect against COVID-19: the role of conspiracy beliefs, trust, and endorsement of complementary and alternative medicine. *BMC Public Health* 21:684. doi: 10.1186/s12889-021-10643-w
- Šrol, J., and Ballova Mikušková, E., Cavojeva, V. (2021). When we are worried, what are we thinking? Anxiety, lack of control, and conspiracy beliefs amidst the COVID-19 pandemic. *Appl. Cognit. Psychol.* 35, 720–729. doi: 10.31234/osf.io/f9e6p
- Stenner, K. (2005). *The Authoritarian Dynamic*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511614712
- Šuljok, A. (2020). Znanstvena pismenost i stavovi prema znanosti u Hrvatskoj (Scientific literacy and attitudes towards science in Croatia). *Sociol. Prostor* 58, 85–111. doi: 10.5673/sip.58.1.4
- Swami, V. (2012). Social psychological origins of conspiracy theories: the case of the Jewish conspiracy theory in Malaysia. *Front. Psychol.* 3:280. doi: 10.3389/fpsyg.2012.00280
- Swami, V., Coles, R., Stieger, S., Pietschnig, J., Furnham, A., Rehim, S., et al. (2011). Conspiracist ideation in Britain and Austria: evidence of a monological belief system and associations between individual psychological differences and real-world and fictitious conspiracy theories. *Br. J. Psychol.* 102, 443–463. doi: 10.1111/j.2044-8295.2010.02004.x
- Swami, V., Voracek, M., Stieger, S., Tran, U. S., and Furnham, A. (2014). Analytic thinking reduces belief in conspiracy theories. *Cognition* 133, 572–585. doi: 10.1016/j.cognition.2014.08.006
- Todosijević, B. (2013). Socijalni, psihološki i ideološki koreni nacionalističkih stavova u Srbiji (Social, psychological and ideological roots of nationalist attitudes in Serbia). *Psihologija* 46, 279–297. doi: 10.2298/PSI130411005T
- Uscinski, J., Klofstad, C., and Atkinson, M. (2016). What drives conspiratorial beliefs? The role of informational cues and predispositions. *Polit. Res. Quart.* 69, 57–71. doi: 10.1177/1065912915621621
- Uscinski, J. E., Enders, A. M., Klofstad, C., Seelig, M., Funchion, J., Everett, C., et al. (2020). Why do people believe COVID-19 conspiracy theories? *Harvard Kennedy School Misinform. Rev.* 1. doi: 10.37016/mr-2020-015
- van der Linden, S. (2015). The conspiracy-effect: exposure to conspiracy theories (about global warming) decreases pro-social behavior and science

- acceptance. *Pers. Individ. Dif.* 87, 171–173. doi: 10.1016/j.paid.2015.07.045
- van Mulukom, V., Pummerer, L., Alper, S., Bai, H., Cavojoja, V., Farias, J. E. M., et al. (2020). A dual-inheritance model of COVID-19 conspiracy beliefs: a systematic review. *PsyArXiv [Preprint]*. doi: 10.31234/osf.io/u8yah
- van Prooijen, J.-W., and Douglas, K. M. (2017). Conspiracy theories as part of history: the role of societal crisis situations. *Memory Stud.* 10, 323–333. doi: 10.1177/1750698017701615
- van Prooijen, J. W., and Douglas, K. M. (2018). Belief in conspiracy theories: basic principles of an emerging research domain. *Eur. J. Soc. Psychol.* 48, 897–908. doi: 10.1002/ejsp.2530
- Walter, M. I., Thorpe, G. L., and Kingery, L. R. (2001). The common beliefs Survey-III, the situational self-statement, and affective state inventory and their relationship to authoritarianism and social dominance orientation. *J. Rational-Emotive Cogn. Behav. Ther.* 19, 105–118. doi: 10.1023/A:1011131521933
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One Hundred and Sixty-One Days in the Life of the Homopandemicus in Serbia: The Contribution of Information Credibility and Alertness in Predicting Engagement in Protective Behaviors

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COVID-19 pandemic is a long-lasting process associated with dynamic changes within society and in individual psychological responses. Effective communication of measures by credible sources throughout the epidemic is one of the crucial factors for the containment of the disease, and the official communication about pandemics is straightforwardly directed toward changes in behavior via engagement in (self-)protective measures. Calls for the adherence to these measures are aimed at the general population, but people's reactions to these calls vary depending on, for example, their individual differences in cognitive and emotional responses to the situation. The focus of our study was the general narrative about the epidemic as conveyed by both state officials and media outlets in times of decreased social contacts due to the quarantine, in which relying on these sources of information is even more pivotal. Our aim was to explore the stability of the proposed mediational model during the course of the epidemic in Serbia. In the model, we tested the relationship between perceived credibility of information (PCI) and two types of protective behavior—the actual self-protective behavior (ASPB) and the hypothetical protective behavior (HPB), as well as the potential mediating role of alertness in these relationships time-wise. A cross-sectional study ($N = 10,782$, female = 79.1%) was being administered daily during the first epidemic wave and in three more 2-week time frames during the second wave. Based on the variability of these measures during the first epidemic wave, three stages of psychological responses were mapped (acute, adaptation, and relaxation stage), which were observed, with some deviations, also in the second wave. The mediational model was relatively robust after the initial few weeks, but the strength of pairwise relationships was more changeable. With both types of protective behaviors, the predictive power of PCI was partially mediated through alertness. This suggests that, while individual differences in cognitive and affective responses are important, so is coherent, focused, and credible

communication in all stages of the epidemic, which emphasizes the communality aspect of the social containment of the infection. Our findings can thus be valuable in informing the planning of effective future communication.

Keywords: COVID-19, coronavirus, credibility of information, alertness, self-protective behavior, protective behavior, pandemic stages, cross-sectional

INTRODUCTION

The epidemic of COVID-19 has been seriously affecting people's daily lives (Wang et al., 2020) and continues to do so. It has forced many countries around the world to adopt strict measures to contain the spread of the infection, including restricting social contacts, stopping public life, and keeping people under prolonged lock-downs. Studies conducted during previous epidemics, but also during the current COVID-19 pandemic, have shown that widespread occurrence of an infectious disease is indeed a source of stress (e.g., Cheng and Cheung, 2005; Casagrande et al., 2020; Kavčič et al., 2020; Petzold et al., 2020), not only because of growing concern and fear of the disease, but also because people have to adapt their lives to avoid becoming infected (e.g., Leung et al., 2005b). Moreover, global disease outbreaks are not one-time events, but longer-lasting processes associated with dynamic changes within society. Consequently, emotional and behavioral responses can change dramatically throughout the course of the outbreak, and especially after the occurrence of certain critical events or contextual changes (MHCC, 2012). At the same time, people respond differently to health threats and these individual differences may affect their health behavior (Brewer et al., 2007; Ferrer and Klein, 2015), which is crucial in curbing the spread of the disease.

While the effectiveness of different preventive measures and adherence to them on a population level has been quantitatively studied using mathematical models (e.g., Cacciapaglia et al., 2020; Cot et al., 2021), our focus was on the individual. We therefore focused on how perceptions related to COVID-19 and especially health-protective behavior differed from the confirmation of the first cases in Serbia in March through the official end of the COVID-19 associated state of emergency in May and beyond—until the end of the second epidemic wave in August. Furthermore, as epidemic outbreaks are related to significant and much needed behavioral changes that are only effective if their adoption is widespread (e.g., OECD, 2020), we were interested in whether the perception of the information received about COVID-19 is linked to protective behavior, and what is the role of individual differences in perceptions of the epidemic situation in this relationship.

Credibility of Information

In order for people to behave appropriately and in accordance with the protective measures, each stage of the outbreak and the corresponding responses must be effectively communicated to

the general public by both government and health officials, as well as the media (Reynolds and Seeger, 2014). In a situation of total lockdown, reduced social contact and increased risk of infection with the novel coronavirus, unknown to the general public, reliance on information from official sources is even more critical than in a non-crisis period (Austin et al., 2012; Chauhan and Hughes, 2017). From the beginning of the outbreak until its eventual control, but also during the follow-up period when the risk of a repeated outbreak is mitigated, public health authorities are expected to provide timely and accurate information and answers to the news media about the effects of the outbreak (Tumpey et al., 2018; WHO, 2018). These non-disputable facts provide the core of the information environment surrounding an epidemic. Indeed, numerous calls have been made about the importance of effective communication in fighting the infodemic (overflow of information with questionable validity; The Lancet, 2020).

One of the key features of this communication is the perceived credibility of the sources of information. Sources that are perceived as credible are more persuasive (Petty and Brinol, 2008; O'Keefe, 2016), and the credibility of information derives from the expertise and trustworthiness of the source (Van Bavel et al., 2020). Employing credible sources capable of sharing official public health facts has been shown to improve the effectiveness of public health messages in inducing behavioral change during epidemics (Lewandowsky et al., 2013; Greyling et al., 2016; Vijaykumar et al., 2018; Vinck et al., 2019; Van Bavel et al., 2020). In addition, credible information and public health messages from national leaders and health officials are required, and in line with the demands for effective communication, the media are a key factor in promoting healthy behavior (Sandman, 2009; Wakefield et al., 2010).

Due to the changing nature of the threatening event, people's trust in various institutions and information sources can change dynamically during the outbreak. Studies have shown that public support for the government during the H1N1 outbreak in Hong Kong in 2009 decreased over time (e.g., Yeung et al., 2017). Similarly, public trust in institutions in Switzerland decreased during the same outbreak (Bangerter et al., 2012). The trust in government and in medical institutions had a negative effect on anxiety, and at the same time it was found that the negative effect was stronger during the SARS outbreak than during the period thereafter (Cheung and Tse, 2008). A lack of trust in public health officials undermines the credibility of the information provided by officials, which may lead to lower levels of utilization of health services (Alsan and Wanamaker, 2018). In addition, alarming framing aimed at exaggerating the level of danger and intensive reporting in the mass media could trigger fear and hysteria (Van den Bulck and Custers, 2009). This, in turn,

Abbreviations: ASPB, actual self-protective behaviors; CAB model, credibility-alertness-behavior (mediational) model; HPB, hypothetical protective behaviors; PCI, perceived credibility of information.

may limit the possibilities for mobilizing the public to adopt protective and health promoting behavior (Sherlaw and Raude, 2013). Additionally, negative emotions can also be amplified by prolonged exposure to negative reporting (Brug et al., 2004; Lau et al., 2010). Threatening and blaming discourse, negative allegations and the interference of personal emotions in the risk communication of pandemics undermine appropriate risk communication (Reynolds and Quinn Crouse, 2008). All this is contrary to the objectives of officials and health professionals and the general public interest.

As in many countries worldwide, the state reacted quickly in Serbia, and since mid-March, when the state of emergency was declared, numerous measures have been in force. Throughout this period, COVID-19 has been in the spotlight of coverage in various media. We focused on the official channels of pandemic-related communication, as the official media coverage was constant, relatively homogenized, and independent from the influences that less formal means of communication are subject to. Press conferences were held by appointed members of the crisis staff who informed public about the overall situation in the healthcare system (e.g., resources, designated COVID-19 hospitals, etc.), the official numbers of newly registered and total COVID-19 cases and deaths, both in Serbia and worldwide, as well as new and potential measures. They were broadcast daily during most of the first as well as the part of the second wave. During intermittent periods, press conferences were held a few days apart. Moreover, local and national television and radio stations, newspapers and news portals were, and still are, regularly reporting about coronavirus related numbers, stats, domestic, and international coronavirus-related news. In Serbia too, as is the case worldwide, the COVID-19 pandemic has established its association with every aspect of life, ranging across health, society, the economy, politics, the environment, sports, recitation, arts and culture, the media, innovation, and technology (Parvin et al., 2020). There was almost no news and stories unrelated to the epidemic covered by media outlets, even if dealing with some other, otherwise current topics. As different stages require different measures (WHO, 2018), we focused on the entire duration of the epidemic in Serbia, and examined how credible information sharing at different times could be efficient.

Emotional Responses to Epidemic Situation and Alertness

As with perception of the information received, the extensive literature on past epidemics shows that emotional and behavioral responses change dramatically after the occurrence of certain critical events or after contextual changes, suggesting that these responses fluctuate across situations and over time (Theorell et al., 2005). The high increase in anxiety and similar emotional responses at the very beginning of the outbreak has been reported in studies conducted during the early stages of COVID-19 outbreak worldwide (Erceg et al., 2020; Garcia de Avila et al., 2020; Lep et al., 2020; Moghanibashi-Mansourieh, 2020; Özdin and Bayrak Özdin, 2020; Shevlin et al., 2020; Shiina et al., 2020; Wang et al., 2020). This abrupt increase in psychological distress was also observed during previous epidemics, followed by a

decrease in intensity without any changes in the environment. For example, in a multiple-time-point study conducted during 4 weeks of the SARS outbreak in Hong Kong, the fluctuations in the state anxiety of the participants were measured over several points in time (Cheng and Cheung, 2005). The anxiety initially increased sharply and then gradually decreased at subsequent time points. In other words, although the outbreak continued to escalate and the number of deaths was still increasing, people's anxiety was lower at the last assessment than at the previous one. Apart from anxiety, various related perceptions may also be subject to the changes described. Yeung et al. (2017) conducted a longitudinal study during the H1N1 outbreak and found that the perceived severity of H1N1 virus infection and perceived susceptibility to infection decreased as the epidemic progressed, suggesting that the public gradually perceived a lower risk from the H1N1 virus. As the epidemic progresses, the psychological response adapts to the constantly changing circumstances, as with other universally stress-triggering events. When people endure psychological stress, they are usually first alarmed or struck by the occurrence of the dangerous event to which they react with highly intense emotional and behavioral reactions. When this initial impact is over, the next phase is less intense and involves resistance or possible recovery and adaptation in which the new daily routines take place, while the emotions relating to the epidemic are less sharp and dramatic. The last phase can be either exhaustion, burnout, or relaxation (Selye, 1946; Daly and Robinson, 2020).

However, Kiviniemi et al. (2018) emphasize the complex relationships between cognition and affect, especially in the field of health psychology. The concern or fear associated with health problems are often seen as emotional, unidimensional entities, although they can—to some extent—blend affect and cognition. In line with this, worry can be seen as an affect-laden cognitive process which, for example, involves affect occurring because of cognitions about a health problem or behavioral outcome. Therefore, in the present research we did not focus on traditional measures of anxiety, but rather observed the current alertness of the participants. The latter represents a more general pattern of people's cognitive propensity to observe and reflect on an epidemic and emotions that cause distress both in relation to the present moment, such as worry, and to future possibilities, such as fear of infection. Employing a serial cross-sectional design with daily measurements, our aim was to explore the differences in mean levels of perceived credibility of informational sources and alertness over the course of the pandemic, and how both could be utilized in predicting individual behavioral responses.

Individual Responses and Protective Behavior

People's behavior and adherence to protective measures are fundamental factors in containing the disease, at least until the vaccine is available (Reynolds and Quinn Crouse, 2008; WHO, 2008; Tumpey et al., 2018; Van Bavel et al., 2020). Success in containing the spread of infection depends on people's compliance with the measures that may be under the influence of different individual characteristics and responses. Studies

investigating factors positively influencing compliance with protective behavior showed an association between emotional and behavioral responses to the epidemics. A study conducted in 2009 during the H1N1 flu epidemic in the United States showed that affective variables, such as self-reported anxiety about the epidemic, mediate the likelihood that respondents will adopt protective behavior (Jones and Salathe, 2009). The results of the study, which included 10 cross-sectional surveys in Hong Kong, also showed a strong association between affective measures (i.e., affective measures of H1N1 risk perception) and adoption of protective behavior compared to cognitive measures of risk perception (Liao et al., 2014). Although this study showed that affective components consistently contribute to the adherence of protective behavior during an epidemic, other studies showed that this association remains positive in the early stages of the epidemic, but is usually not significant in the later stages (Leung et al., 2005a).

Moreover, the frequency of the use of different behavioral strategies during the epidemic changes over time, similar to the changes in emotional responses. During the H1N1 epidemic in Hong Kong various protective behaviors such as the use of facemasks or avoiding touching the face became increasingly less and less prevalent (Yeung et al., 2017). Similarly, during the SARS epidemic in Hong Kong, the practice of personal hygiene first increased and then slightly decreased, while avoidance strategies also increased strongly after the first assessment and then remained constant over time. At the same time, strategies related to the participants' search for information gradually decreased (Cheng and Cheung, 2005). Another study conducted during the initial phase of the SARS outbreak in Hong Kong showed that protective behaviors such as wearing a mask, washing hands, disinfecting at home, avoiding crowded places, and public transport increased significantly at the beginning, but only wearing a mask and washing hands remained at high levels, while a decrease was observed in all other protective behaviors (Lau et al., 2003). A study on public reactions during the early phase and peak of the H1N1 influenza in Greece also showed that during the peak of the pandemic compared to the early phase, participants reported adopting less protective behaviors (washing hands, avoiding crowds, asking a doctor for guidelines, etc.; Karademas et al., 2013). The authors concluded "such findings imply that perceptions, reactions and their relationships may change over the course of an epidemic influenza outbreak and may depend on several factors. Therefore, findings regarding public response at one epidemic phase may not apply to another." (Karademas et al., 2013, p. 426). If affective responses and protective behavior change dynamically during the epidemic, the question remains whether the relationship between them is stable or does it also change during the epidemic.

The Present Study

In sum, the aim of the present study was to examine the relationship between the perceived credibility of information (PCI), people's alertness, and their engagement in protective behavior over the course of an epidemic. Previous studies have shown that both alertness and perceived credibility are related

to protective behavior (e.g., Cheung and Tse, 2008; Liao et al., 2010). However, the credibility of information might be directly related to engagement in protective behavior, or the credibility of information might spark or hinder alertness, which in turn would have an effect on engagement in protective behavior. Based on previous findings about the outbreak of COVID-19 in a culturally similar environment in Slovenia (Lep et al., 2020), where emotional responses to the epidemic were found to be related to the adoption of different protective behaviors, we tested the proposed mediational model and observed its stability over time as the pandemic progressed.

In addition, we also focused on changes in various psychological perceptions and reactions (e.g., participants' alertness, engagement in protective behaviors, and the perceived credibility of the information received) in view of the progression of the pandemic in Serbia, with the aim of gaining an insight into how these factors could be incorporated in policy-making to form interventions that encourage engagement in behaviors aimed at containing the spread of the disease while reducing negative emotional reactions, resulting in a shorter time frame of restrictive measures.

MATERIALS AND METHODS

Sample

A cross-sectional study was conducted during the period of 24 weeks, from March 8th 2020 to August 15th 2020. All participants ($N = 10,782$, female = 79.1%) were legal adults –18 years old or older, native speakers of Serbo-Croatian language and Serbian residents, recruited via 1ka.si survey application using the Facebook advertising and snowball sampling method. They were between 18 and 92 years old ($M = 39.98$, $SD = 13.31$), and of adequate range in terms of educational level and the geographic distribution of population in the country. The sample size varied from day-to-day (between $n = 13$ and $n = 396$; 2 days with <10 participants were excluded from the analyses) and on weekly level (between $n = 150$ and $n = 1,368$; we excluded 2 weeks with <150 participants). Number of participants per day was larger initially, but it diminished over time when the epidemiological situation in Serbia improved (see **Supplementary Table 2**). Participants were not reimbursed for participation.

Materials

The presented measures were part of a larger battery of tests used in the research on emotional and behavioral responses relative to trust in different sources of information during the first 48 h after the first confirmed case in Slovenia (Lep et al., 2020). For the present study we assessed alertness, actual self-protective behavior (ASPB) and hypothetical protective behavior (HPB), as well as the PCI about COVID-19 received by different sources. All measures were translated to Serbian by native speakers and, when needed, adapted to the Serbian context of the COVID-19 epidemic. The data on daily numbers of cases and deceased were obtained from the European Center for Disease Prevention and Control (ECDC, 2020).

Perceived Credibility of Information

Perceived credibility of information about the COVID-19 epidemic received from various information sources was measured using six items, rated on a five-point Likert-type scale (ranging from 1—not at all credible to 5—completely credible). The items referred to different available sources of COVID-19 information in the media. Participants were instructed to rate how credible they found the information they received about the coronavirus in the media from the following sources: the representatives of the Ministry of Health, Institute of Public Health of Serbia representatives, Medical chamber representatives, medical doctors, scientists, and journalists. Principal component analysis (PCA) revealed one principal component, which explained 70% of the variance in the dataset with an eigenvalue of 4.22. The reliability analysis indicated that the scale had very high internal consistency ($\alpha = 0.92$). For complete scale see **Supplementary Material**.

Alertness

Five sets of two items, adapted from Li et al. (2020), were used to measure perceptions about and emotional responses to the epidemic, and subsequently aggregated into a cognitive-affective construct dubbed alertness. They referred to the degree of worry, fear of contracting the disease, possibility of limiting its spread, perceived severity, and the amount of thinking about the coronavirus both before and after the first confirmed case of the disease in Serbia. Participants rated each item on a six-point Likert-type scale. The scales were customized in accordance with the corresponding item content (e.g., 1—not at all worried, 6—very worried). A PCA run on all 10 items revealed three components explaining in total 74% of the variance in the data set. The first component pertained to the items measuring worry, fear of contracting the disease, perceived severity, and the amount of thinking about the coronavirus *after* the first confirmed case in Serbia. The third component referred to the same items rated in relation to the time *before* the first confirmed case in Serbia, while the second component pertained to the items measuring the possibility of containment of the disease, both before and after the first confirmed case. As the analysis showed two mirrored factors pertaining to both cognitive and emotional aspects of arousal, differing only in relation to the time the items referred to, we ran a second PCA on the items that loaded heavily on the first and third component. The analysis revealed two components differing by the time to which the items referred. The first component accounted for 57% of the variance with an eigenvalue of 4.59, and the second accounted for 17% of the variance with an eigenvalue of 1.34. For the purposes of this study, we used the four items comprising the first component, that is—alertness (after the first confirmed case). The scale exhibits very high internal consistency ($\alpha = 0.91$), a single component explains 78% of the variance, and has an eigenvalue of 3.14. For complete scale see **Supplementary Material**.

Protective Behavior

To measure protective behavioral responses to the epidemic, we assessed engagement in ASPBs and HPBs. Actual self-protective behavior was measured using 10 items, rated on a

three-point scales (with responses: does not apply, partly applies, and totally applies to me). Items were selected according to the guidelines regarding effective self-protective behaviors (e.g., washing hands thoroughly, not touching face, etc.) posted on websites of WHO and Institute of Public Health of Serbia. We have also added several behaviors, which were not labeled as recommended protective or preventive behaviors, but were registered as frequent in the first days of the epidemic (e.g., stockpiling food or medical supplies).

Hypothetical protective behavior was measured using six items, rated on a five-point Likert-type scale (1—I surely wouldn't, 5—I surely would). Items were selected based on recommendations given by the Ministry of Health and Institute of Public Health representatives regarding steps that should be taken if suspecting coronavirus infection (self-isolation, avoiding family members, skipping work, taking care of personal and the hygiene of home, calling and visiting community Health center).

Principal component analysis for the ASPB scale showed one principal component, which accounted for 46% of the variance, with an eigenvalue of 4.59. The scale had good internal consistency ($\alpha = 0.86$). Principal component analysis of items comprising HPB showed two components: the first pertaining to protective behavior aimed at protecting others, explaining the 40% of the variance with an eigenvalue of 2.42, and the second pertaining to contacting a medical institution accounting for 18% of the variance. Further analysis showed that the answers to questions regarding contacting the medical institution varied based on the official guidelines on what one should do if one suspects they contracted the coronavirus. As the official instructions on whether one should *call* or *visit* the community Health center shifted at some point, so did the majority of respondent's answers to these two questions. Thus, these two items were omitted from further analyses. The HPB scale consisting of four items directed at protecting others exhibited medium internal consistency of 0.67, and acceptable ($\alpha = 0.71$) if one item was excluded (caring for hygiene of oneself and her home). Principal component analysis on 3-item version extracts one principal component accounted for 65% of the variance in the dataset, with an eigenvalue of 1.96. For complete scales see **Supplementary Material**.

Study Design and Procedure

Data collection for this cross-sectional study was initiated within 48 h after the first confirmed case of COVID-19 in Serbia was publically announced. As we were aiming to capture the relationship between observed variables and its stability through time, the survey was administered daily until the end of the first epidemic wave. This period of data collection lasted 10 weeks, and ended a week after the state of emergency was lifted in Serbia and the number of daily infections dropped significantly (at that time, we also observed a significant drop in the number of people responding to our survey; **Supplementary Table 2**). After that, the survey was again circulated in three more time frames, each roughly 2 to 3 weeks apart. These time frames were selected to capture significant changes in the progression of the epidemic (i.e., further rise of infections, peak of the second wave, then second improvement of the epidemiological situation).

The survey was hosted on a Slovenian local survey hosting platform Ika.si that complies with national and European General Data Protection Regulation, guaranteeing participants' anonymity and secure handling of their personal data. We distributed the survey via our personal mailing lists, through colleagues, and using Facebook sharing and advertising.

Participants were firstly informed about the purpose of the study and the conditions of participation. After providing consent to participate, subjects were presented with the battery of tests which comprised scales described in the materials section, as well as scales assessing objective and subjective perception of knowledge about coronavirus, general trust in institutions, sources used for gathering information about the epidemic, and questions about personal general health status which will not be analyzed in this study. After completing the survey, participants provided their demographic information and were finally directed to the end page.

RESULTS

Observed Constructs Over the Course of the Epidemic

For each of the measured variables, we computed daily mean scores. In order to observe more general trends that are less dependent on daily contextual changes, weekly scores were also computed. Both daily and weekly mean scores of the measured constructs are presented graphically in **Figures 1–4** (for daily mean scores see also **Supplementary Table 2**).

Credibility of Information

Measure of PCI started out around midpoint and was increasing for the first three weeks (see **Figure 1B**). After that it started to diminish substantially; by week 4 it was back to the initial level and reached its lowest point during the first wave of the outbreak in week 8 (at the end of April). However, during the first wave, the absolute variability was within one point range and the mean daily score of PCI has never fallen below 2.3 out of 5. After the state of emergency was lifted, it remained relatively stable for another 2 weeks, but during the second wave, PCI decreased further.

Looking into day-to-day changes (**Figure 1A**), we can observe some notable jumps in the mean scores. The first is on March 21st and 22nd, when the number of participants was low in comparison to other days of the survey, and the mean score rises swiftly after that, reaching the highest mean daily score of 3.34 on March 24th. The next drop is observed around March 28th, when the Government of Republic of Serbia centralized the flow of information during the state of emergency (mean score dropped for 0.48 points between March 29th and March 31st). Mean PCI was gradually rising again until April 4th. Until April 16th the mean scores were relatively unstable and after that date, PCI was dropping until the measures were eased in the beginning of May (and the state of emergency was ended shortly after). The lowest daily score during the first wave was observed on May 13th, which was also the only day when the score dropped below 2 out of 5. Daily observations during the second wave are not numerous, but it seems that PCI remained lower than during the first wave

as mean weekly scores continued to decrease in comparison to the week when the state of emergency was lifted ($M_{W9} = 2.52$, $M_{W12} = 2.30$).

Alertness

As with PCI, alertness was also on the rise in the beginning of the epidemic, though mean daily scores were initially higher (above 3.3 out of 6). After alertness scores reached peak on March 24th ($M = 4.79$), a notable drop in alertness was observed in the last two days of March. Even though two more short-term spikes were observed—the first on April 10th, and the second on April 28th—participants' alertness was generally diminishing since the end of March throughout the end of the first wave (see **Figure 2**). A notable spike in daily scores was observed when the number of cases started rising again in the beginning of June. During the second wave, a similar pattern was observed: mean scores were rising during the first weeks and dropped significantly at the end of the second wave. As we did not collect data for every day during the second wave, we are not sure when the peak was reached, however it seems that mean alertness scores were lower than during the first wave.

Actual Self-Protective Behavior

Reported engagement in ASPB started out at midpoint of the scale ($M = 1.54$ on March 8th), but then steadily increased until week three when it plateaued (see **Figure 3**). After that it remained fairly constant for another 4 weeks, when it gradually started to decrease (with daily fluctuations). On a weekly level, one drop was observed around April 21st when the measures were eased for the first time (see **Figure 3B**). Still, the engagement remained stable after the temporal drop. During the second wave, our results do not point to any significant rise in ASPB, which ultimately dropped below the score 2 out of 3 in week 24. On a daily level, drops of lower magnitude can be observed (e.g., March 28th, April 7th, April 11th, April 15th, April 20th, May 1st), which mostly happened before or during the weekend lockdowns.

Hypothetical Protective Behavior

Conversely to ASPB, reported preparedness to engage in HPB started out relatively high ($M = 4.20$ on March 9th), and rose further until March 23rd ($M = 4.78$). The scores were consistently, albeit slowly, dropping after that date with temporal spikes—most notable on April 1st when the daily mean score of HPB peaked at $M = 4.82$ —though the daily average has never fallen below 4.03 on a 5-point scale until the end of the first wave. At the beginning of the second wave, the scores were the lowest (below 4.0 in week 13; $M = 3.89$); after a surge in week 14, they again remained stable and as with alertness, lower than during the first wave.

Most notable drop in HPB scores was observed from April 16th, reaching a temporal low-point on April 22nd at $M = 4.43$ (when measures were eased for the first time; see **Figure 4A**). Again, a notable drop was observed on a daily level around March 20th, when the number of daily participants was the lowest. While the scores on a weekly level were consistently dropping throughout the second half of April and in the beginning of May

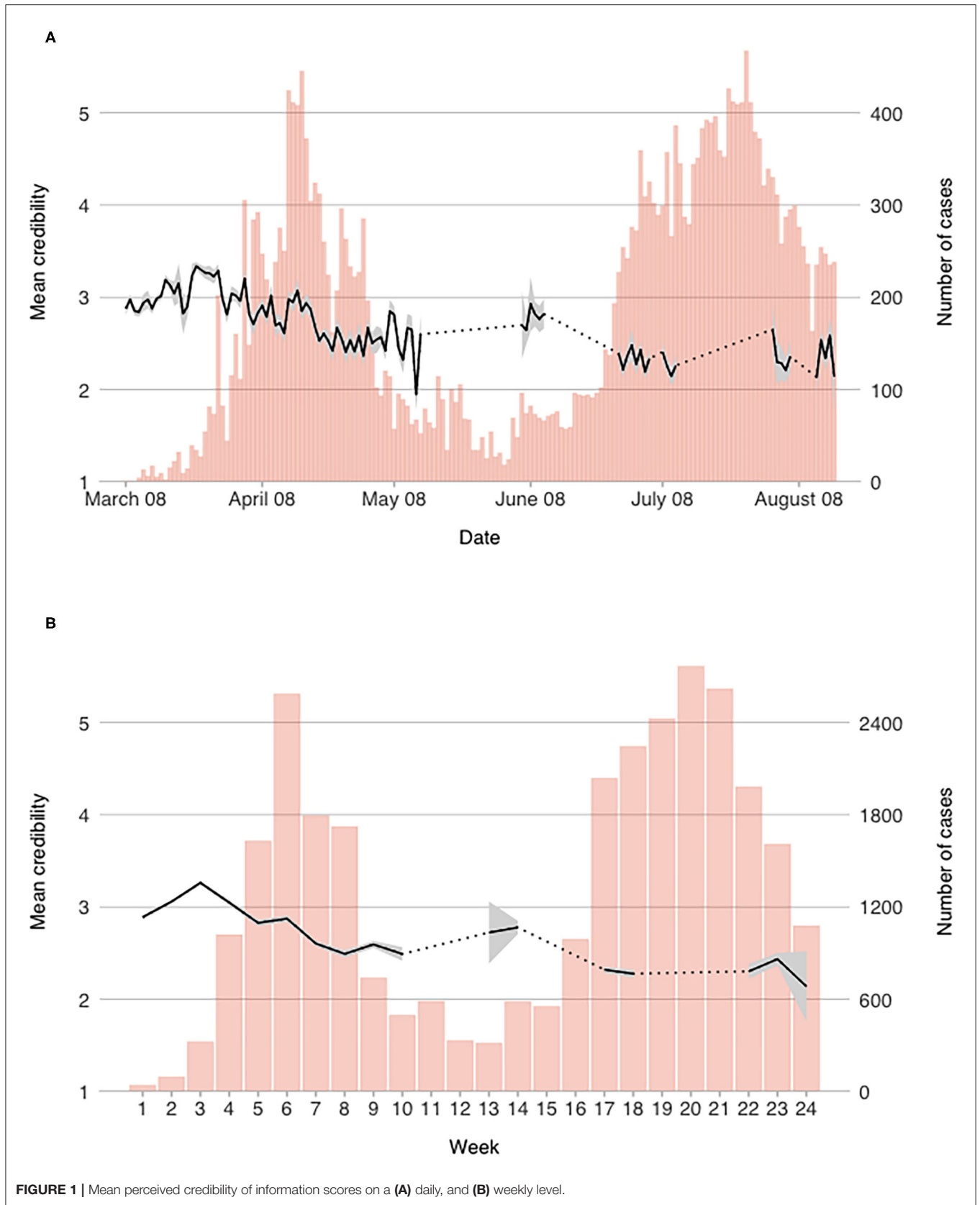


FIGURE 1 | Mean perceived credibility of information scores on a (A) daily, and (B) weekly level.

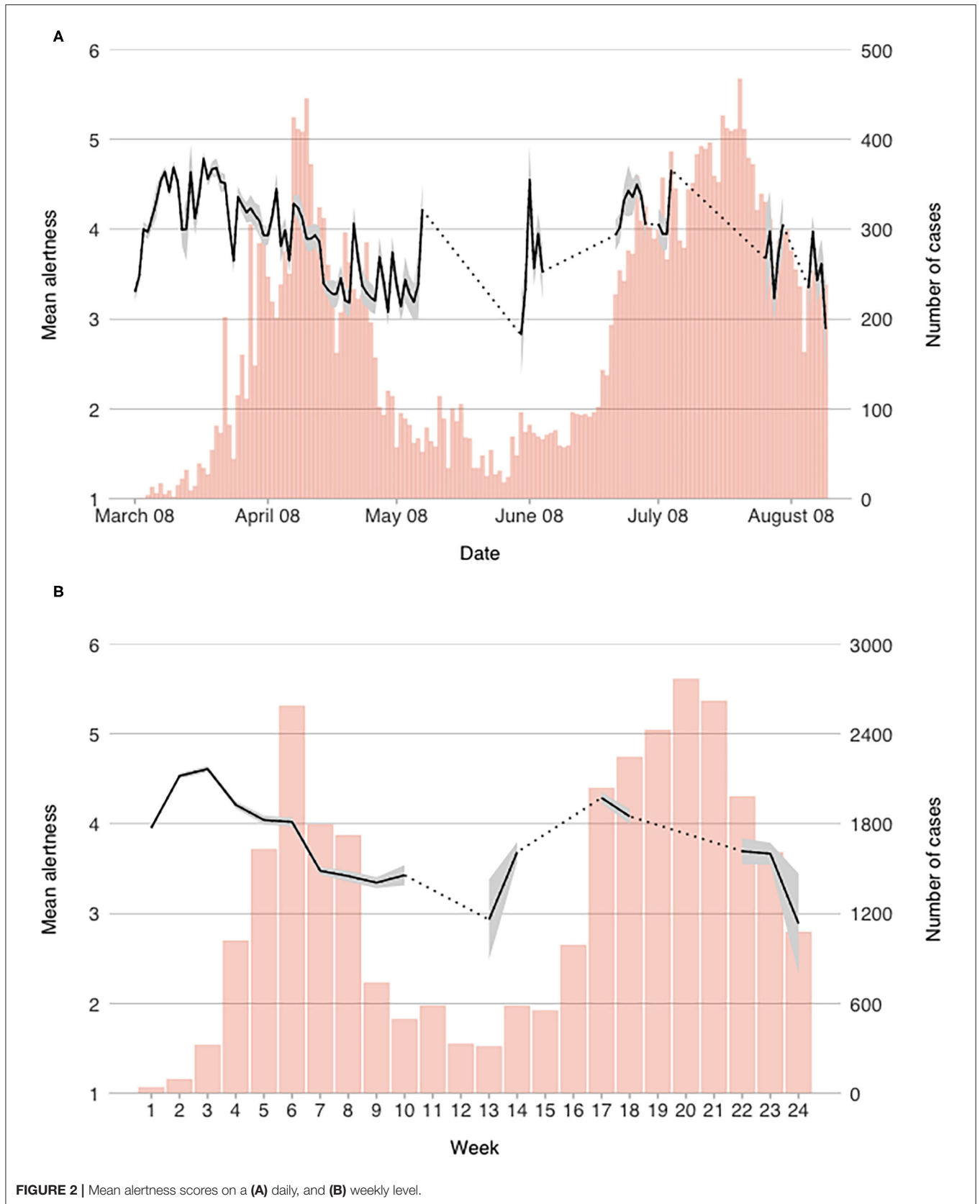
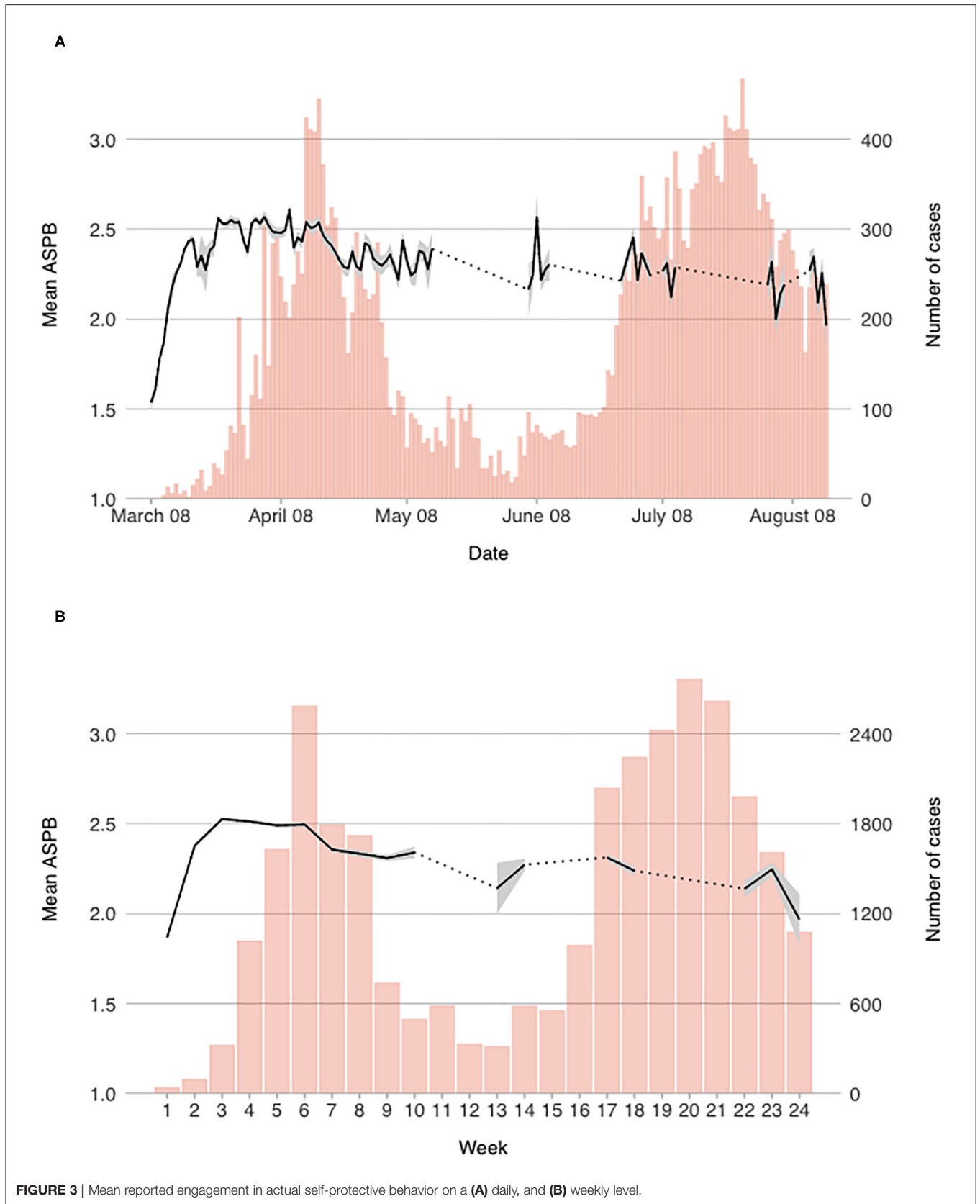
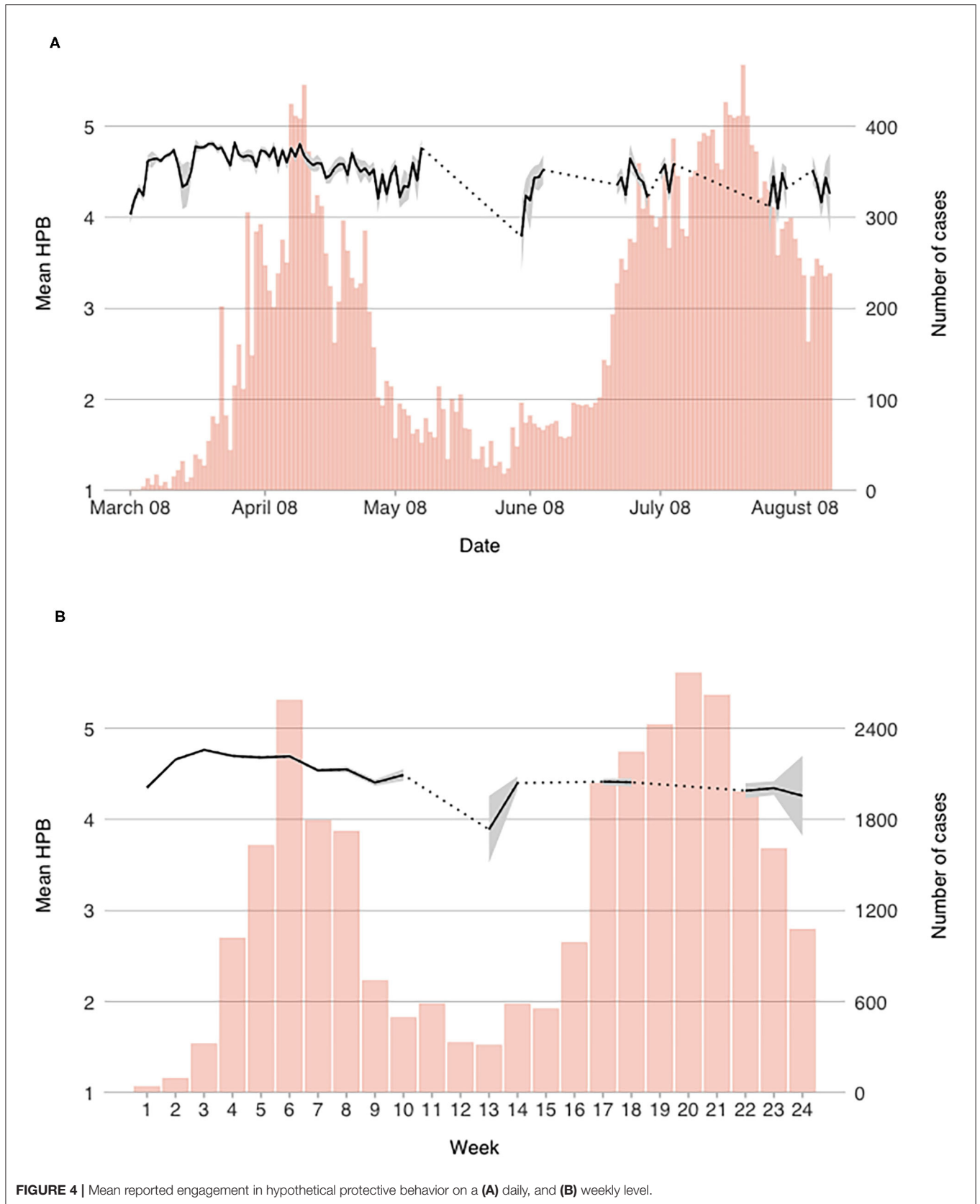


FIGURE 2 | Mean alertness scores on a (A) daily, and (B) weekly level.





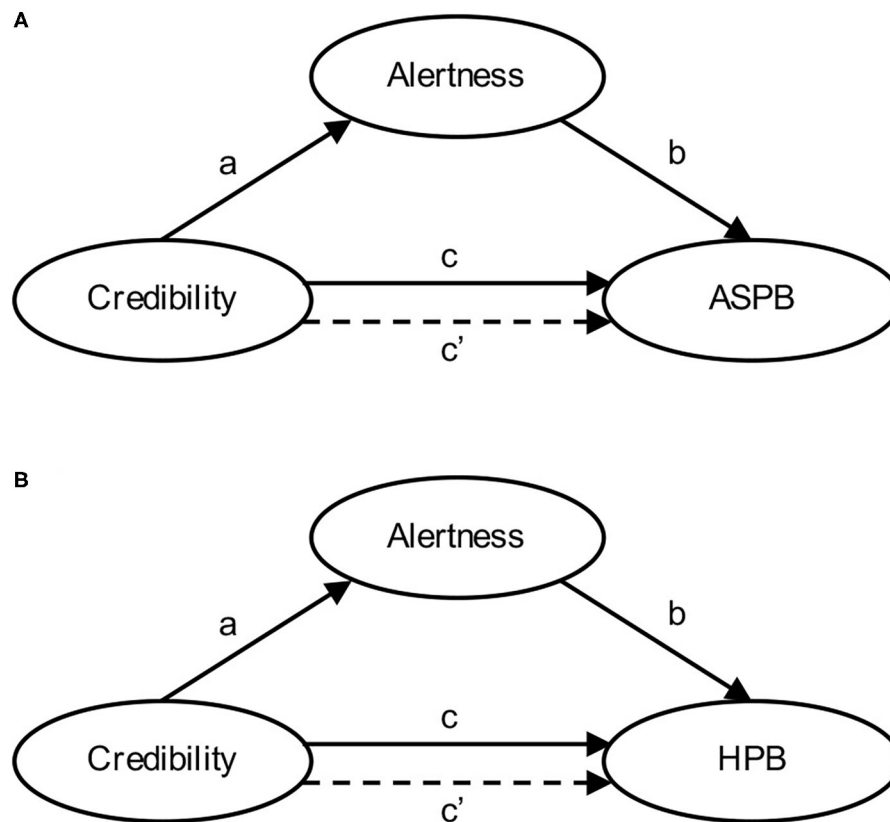


FIGURE 5 | Proposed mediation models for predicting engagement in actual self-protective behavior (ASPB) and hypothetical protective behavior (HPB).

(see **Figure 4B**), scores on a daily level were relatively volatile in the first half of May. The same volatility can also be observed during the second wave, though less data was collected then.

Relationship Between Variables and the Psychological Phases of the Pandemic in Serbia

While the changes in mean levels of observed constructs are not uniform across variables—they do not rise or decrease in unison, and some are relatively stable—there is some resemblance in their patterns of change. On days when the mean alertness scores were higher, so was the reported engagement in both ASPB (r between daily mean scores = 0.39, $p < 0.001$) and HPB ($r = 0.54$, $p < 0.001$). When mean daily scores of PCI were higher, so were mean scores of alertness ($r = 0.52$, $p < 0.001$), ASPB ($r = 0.32$, $p = 0.002$), and HPB ($r = 0.52$, $p < 0.001$). Furthermore, there was some overlap between both kinds of behaviors ($r = 0.51$, $p < 0.001$). We also observed whether the changes in the measured constructs were associated with daily numbers of infected or deceased, but those were notable only for PCI—on days with higher number of infected ($r = -0.45$, $p < 0.001$) and deceased ($r = -0.51$, $p < 0.001$), the participants perceived the credibility of information as lower. Their engagement in ASPB was slightly higher on days with higher numbers of infected ($r = 0.25$, p

$= 0.013$), but was unrelated with daily numbers of deceased ($r = 0.11$, $p = 0.271$). Similarly, engagement in HPB and alertness were unrelated either to number of infected ($r_{\text{HPB}} = -0.01$, $p = 0.936$; $r_{\text{alertness}} = -0.10$, $p = 0.333$) or deceased ($r_{\text{HPB}} = -0.07$, $p = 0.475$; $r_{\text{alertness}} = -0.09$, $p = 0.372$).

Based on the changes in mean levels of the described variables as well as the external events, we divided the observed time frame into several phases. First, we divided the time until the state of emergency was lifted (which roughly corresponds to the first wave of infections) into three phases. The acute phase (March 8th—March 25th) is characterized by rising alertness, PCI and engagement in both ASPB and HPB and by first confirmed cases (and deaths) of COVID-19 in Serbia and the subsequent spread of the disease and introduction of ever-stricter official measures. During the adaptation phase (March 26th—April 21st) mean scores of alertness and engagement in protective behaviors ceased to rise, but remained fairly stable while the measures remained in effect and people were adapting to the new reality. The last phase, dubbed the relaxation phase (April 22nd—May 9th), could lastly be described by the diminishing number of new cases and eventual loosening of the official measures, while on the psychological level, alertness and PCI, were diminishing and people were engaging less in protective behaviors.

Further phases correspond to our data collection windows, as data was not collected on all days beyond the first wave.

Phase four, the latent phase (beginning on May 10th) pertains to the time between the two waves, when the number of cases was comparably low, and the number of measures were relaxed. During this time, all the scores remained relatively low, as people were less alert and reported of lower engagement in ASPB and HPB. During the second wave of infections, the phases largely mirrored those of the first one. The latent phase is followed by the second acute phase (beginning on June 6th). Then, an increase in alertness, engagement in protective behavior, and PCI were observed. While the changes seem to occur over a similar time period (3–4 weeks), they were of a smaller magnitude. The second adaptation phase (June 26th–July 11th) is less clear: while PCI and HPB scores seemed to settle, alertness, and ASPB were more volatile, and larger daily changes were observed. As in the first wave, decreases of all scores were observed as the epidemiological situation improved and people, on the psychological level, entered the second relaxation phase (August 2nd–August 16th).

The Role of Information Credibility and CAB Mediation Models

To explore how PCI is related to ASPB and HSP, two mediation models were tested (see **Figure 5**)—in both, PCI was a predictor, alertness was the mediator, and either ASPB or HPB were the outcome. Mediation was tested using R package lavaan (Rosseel, 2012) and confidence intervals were assessed using bootstrap. Each model was first tested for the entire study period, following the exploration of week-to-week (in the first wave), and phase-to-phase (throughout the pandemic) stability. We assessed the difference between total and direct effect using an online applet by Lee and Preacher (2013), and effect size was calculated as a simple ratio between indirect and total effects (Jose, 2013).

Actual Self-Protective Behavior

The overall relationship between PCI and ASPB was moderate (see **Table 1**), and partially mediated by the alertness scores. However, the strength of the relationship varied between weeks and phases of the epidemic (between $c = 0.20$ and $c = 0.47$). Predictive power of PCI on ASPB was weak in phase 1 (the acute phase), but higher in phases 3, 5, and 7, when the reported number of infected was lower. In all the phases, the effect was mediated by alertness: between 35% in phase 5 ($c = 0.44$, $c' = 0.29$, 95% CI [0.19, 0.38]), and 65% in phase 2 ($c = 0.37$, $c' = 0.13$, 95% CI [0.10, 0.16]). Overall, PCI and alertness explained almost a half of variability in ASPB scores. See **Figure 6** for the graphical representations of results of the mediation analysis for each of the phases and for overall dataset.

Looking into the relationship between variables on a weekly level during the first wave, we can see that the total effect was gradually rising (starting at $c = 0.06$ in the first week, and rising to $c = 0.47$ in week 9). The predictive power of PCI on alertness was initially non-significant ($a = 0.04$, 95% CI [−0.03, 0.10]), while it rose to $a = 0.42$ (95% CI [0.36, 0.48]) in week 4, and remained relatively unchanged until week 10. During the second wave, the predictive power was lower (between $a = 0.25$ and $a = 0.30$), but increased again in the last week of measurement ($a = 0.46$, 95% CI [0.36, 0.56]). The predictive power of alertness on ASPB was

higher and comparably more stable throughout the course of the epidemic (between $b = 0.51$ and $b = 0.68$). With the exception of Weeks 1 and 10, when the change in path coefficients due to mediation was non-significant, the direct effect was consistently mediated by alertness.

Hypothetical Protective Behavior

As with ASPB, the total effect of PCI to HPB and the a-path from PCI to alertness were initially weak ($c = 0.02$, $a = 0.04$) but they rose to moderate in week 9 ($c = 0.27$, $a = 0.43$). On the other hand, the predictive power of alertness in predicting HPB scores was relatively stable, albeit lower than with ASPB (see **Table 2**). Here, the mediation model accounted for less than a fifth of variability in HPB scores. However, variability of HPB scores was significantly lower in comparison to ASPB. The mediation models for each of the phases and whole duration of the pandemic are presented in **Figure 7**.

In weeks 1 and 3, the inclusion of alertness fully mediated the PCI-HPB link, and later the relationship was only partly mediated with alertness accounting for between 22 and 60% of the total PCI to HPB effect (note that the differences between c and c' estimates were not all statistically significant). The mediation model was relatively stable over the proposed phases of the epidemic, however, both direct and total effects were doubled in later phases when comparing to the acute phase (see **Table 2**).

DISCUSSION

As in over 70 countries worldwide, the state response to COVID-19 outbreak in Serbia was immediate and broad. The first patient with COVID-19 in Serbia was registered on March 6th, and the first official state measures took place on March 15th, when the Serbian government declared the state of emergency, which was merely 4 days after the WHO declared pandemic. This was followed by relatively strict measures: instating the police curfew on March 17th, online schooling, and complete ban on leaving the house for senior citizens over the age of 65 (for an overview of the imposed measures, see **Supplementary Table 1**). The police curfew lasted on average for 12 consecutive hours on working days, while on weekends it was soon prolonged to 36 and even up to 84 h straight during the Easter weekend. Naturally, media outlets treated the pandemic as breaking news and sustained coverage began even before the first case of COVID-19 was confirmed in Serbia. Consequently, the COVID-19 related news comprised the vast majority of all daily media content. Through frequent official briefings and across various non-governmental informational sources, a myriad of changes to the measures, pleas for action and instructions were communicated to the public. In the present research, we were interested in how the public's perceptions of the information received and their alertness has changed, and how the PCI in different stages of the epidemic was related to actual and HPB.

Psychological and Behavioral Unfolding of the Pandemic

As the pandemic is a lasting event, its progression was interrelated with changes in emotional and cognitive, as well as

TABLE 1 | Mediation analysis results for Actual self-protective behavior (ASPB) credibility-alertness-behavior (CAB) model.

Time period	Model 1		Model 2								Z	p	R		
	c	95% CI	a	95% CI	b	95% CI	c'	95% CI	a*b	95% CI				tot	95% CI
Overall	0.31	[0.29; 0.32]	0.34	[0.32; 0.36]	0.56	[0.55; 0.58]	0.11	[0.10; 0.13]	0.19	[0.18; 0.21]	0.31	[0.29; 0.32]	13.70	<0.001	0.63
Week 1	0.06	[0.01; 0.12]	0.04	[-0.03; 0.10]	0.68	[0.65; 0.71]	0.04	[-0.01; 0.08]	0.03	[-0.02; 0.07]	0.06	[0.01; 0.12]	0.47	0.64	0.39
Week 2	0.19	[0.14; 0.25]	0.14	[0.08; 0.20]	0.59	[0.55; 0.63]	0.11	[0.06; 0.16]	0.08	[0.05; 0.12]	0.19	[0.14; 0.25]	2.07	0.04	0.43
Week 3	0.29	[0.23; 0.35]	0.32	[0.25; 0; 0.38]	0.51	[0.46; 0.56]	0.13	[0.07; 0.18]	0.16	[0.12; 0.20]	0.29	[0.23; 0.35]	3.80	<0.001	0.56
Week 4	0.39	[0.34; 0.44]	0.42	[0.36; 0.48]	0.57	[0.53; 0.61]	0.15	[0.10; 0.20]	0.24	[0.20; 0.28]	0.39	[0.34; 0.44]	5.61	<0.001	0.62
Week 5	0.38	[0.32; 0.44]	0.38	[0.31; 0.44]	0.61	[0.57; 0.65]	0.15	[0.09; 0.20]	0.23	[0.19; 0.27]	0.38	[0.32; 0; 0.44]	4.73	<0.001	0.61
Week 6	0.38	[0.32; 0.44]	0.43	[0.37; 0.49]	0.60	[0.55; 0.65]	0.12	[0.07; 0.18]	0.26	[0.22; 0.30]	0.38	[0.32; 0.44]	4.97	<0.001	0.68
Week 7	0.36	[0.30; 0.41]	0.38	[0.32; 0.43]	0.59	[0.54; 0.63]	0.13	[0.08; 0.19]	0.22	[0.18; 0.26]	0.35	[0.30; 0.41]	4.88	<0.001	0.63
Week 8	0.41	[0.34; 0.48]	0.37	[0.29; 0.45]	0.58	[0.52; 0.63]	0.20	[0.13; 0.26]	0.21	[0.16; 0.26]	0.41	[0.34; 0.48]	2.72	0.01	0.52
Week 9	0.47	[0.41; 0.53]	0.43	[0.36; 0.50]	0.59	[0.53; 0.64]	0.22	[0.16; 0.28]	0.25	[0.21; 0.30]	0.47	[0.41; 0.53]	4.76	<0.001	0.54
Week 10	0.33	[0.20; 0.45]	0.30	[0.15; 0.46]	0.57	[0.45; 0.68]	0.17	[0.03; 0.31]	0.17	[0.07; 0.27]	0.34	[0.21; 0.46]	1.61	0.11	0.51
Phase 1	0.20	[0.17; 0.24]	0.16	[0.12; 0.20]	0.62	[0.59; 0.64]	0.11	[0.08; 0.13]	0.10	[0.08; 0.12]	0.20	[0.17; 0.24]	3.84	<0.001	0.49
Phase 2	0.37	[0.34; 0.40]	0.41	[0.38; 0.44]	0.59	[0.56; 0.61]	0.13	[0.10; 0.16]	0.24	[0.22; 0.26]	0.37	[0.34; 0.40]	1.61	<0.001	0.65
Phase 3	0.42	[0.38; 0.46]	0.40	[0.35; 0.44]	0.59	[0.56; 0.62]	0.18	[0.15; 0.22]	0.23	[0.21; 0.26]	0.42	[0.38; 0.46]	7.06	<0.001	0.56
Phase 4	0.33	[0.20; 0.45]	0.30	[0.15; 0.46]	0.57	[0.45; 0.68]	0.17	[0.03; 0.31]	0.17	[0.07; 0.27]	0.34	[0.21; 0.46]	1.61	0.11	0.51
Phase 5	0.44	[0.32; 0.56]	0.25	[0.10; 0.40]	0.61	[0.51; 0.70]	0.29	[0.19; 0.38]	0.15	[0.06; 0.24]	0.44	[0.32; 0.56]	1.52	0.13	0.35
Phase 6	0.30	[0.24; 0.36]	0.25	[0.18; 0.32]	0.66	[0.62; 0.70]	0.14	[0.09; 0.19]	0.17	[0.12; 0.21]	0.30	[0.24; 0.36]	3.50	<0.001	0.55
Phase 7	0.47	[0.39; 0.56]	0.46	[0.36; 0.56]	0.65	[0.58; 0.71]	0.18	[0.10; 0.25]	0.30	[0.23; 0.36]	0.47	[0.39; 0.56]	4.08	<0.001	0.63

c—total effect (credibility ASPB), a—credibility alertness, b—alertness ASPB, c'—direct effect, a*b—indirect effect, R—ratio direct/indirect effect.

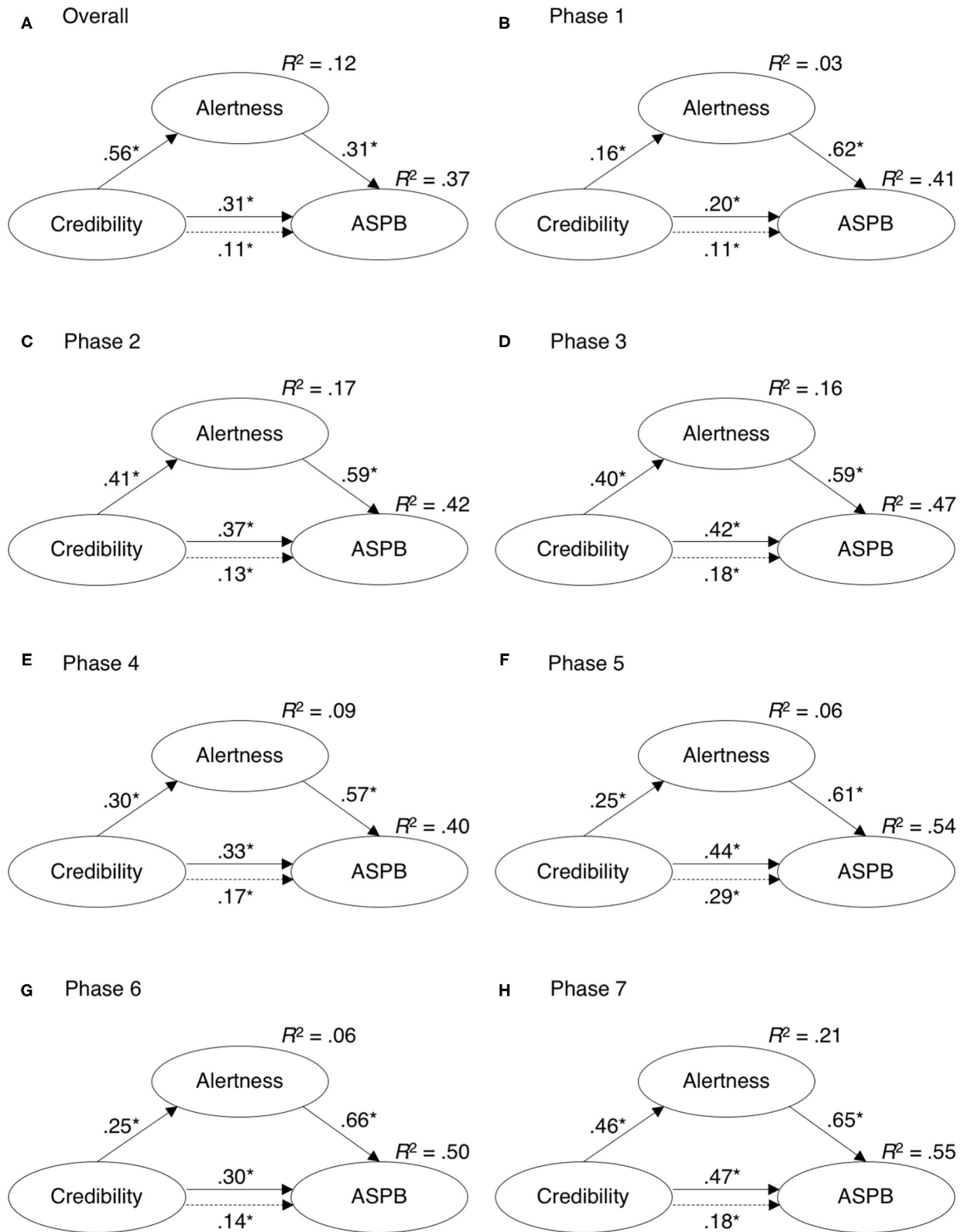
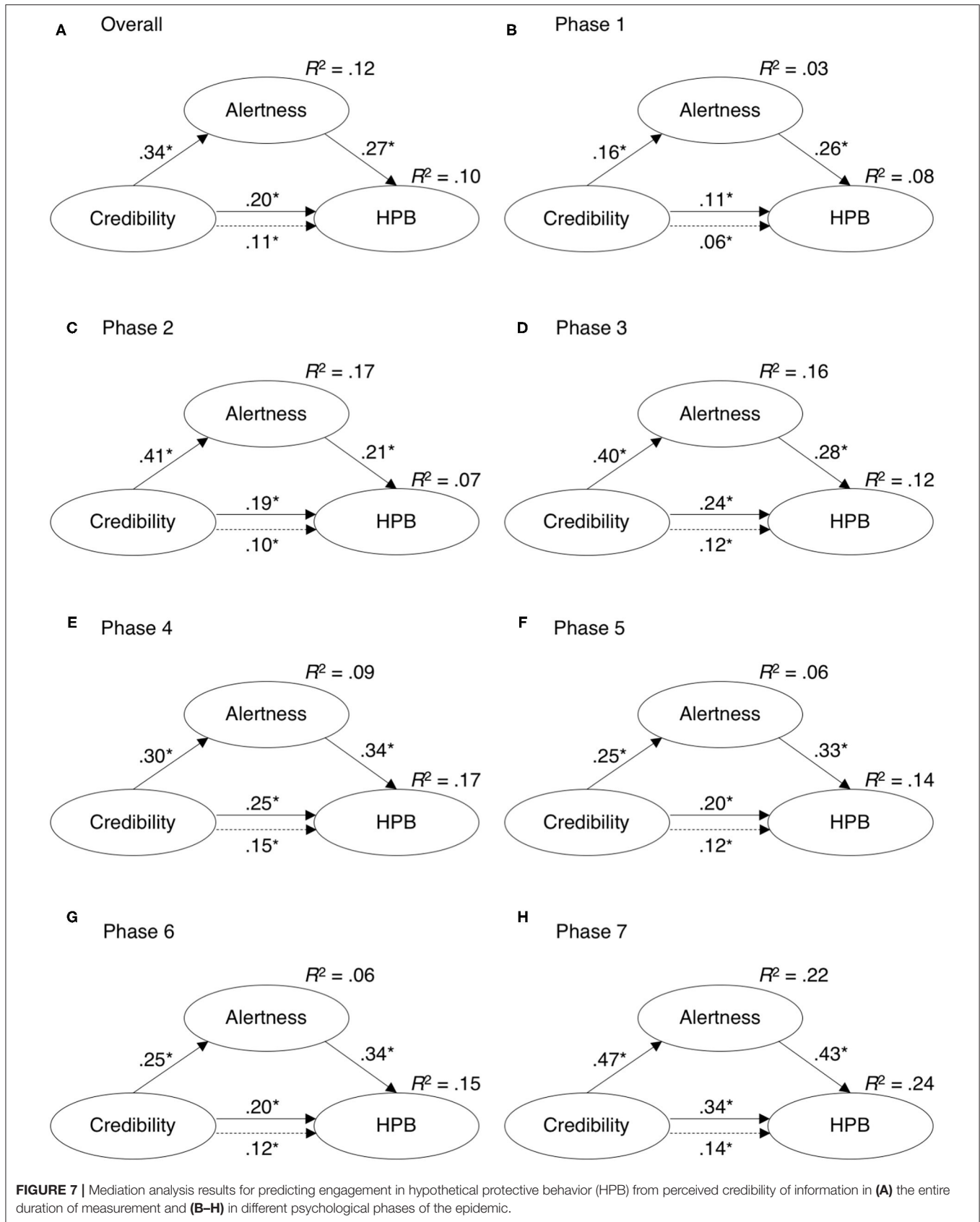


FIGURE 6 | Mediation analysis results for predicting engagement in actual self-protective behavior (ASPB) from perceived credibility of information in **(A)** the entire duration of measurement and **(B–H)** in different psychological phases of the epidemic.

TABLE 2 | Mediation analysis results for Hypothetical protective behavior (HPB) credibility-alertness-behavior (CAB) model.

Time period	Model 1		Model 2										Z	p	R
	c	95% CI	a	95% CI	b	95% CI	c'	95% CI	a*b	95% CI	tot	95% CI			
Overall	0.20	[0.18; 0.22]	0.34	[0.33; 0.36]	0.27	[0.25; 0.29]	0.11	[0.09; 0.13]	0.09	[0.08; 0.10]	0.20	[0.18; 0.22]	7.93	<0.001	0.46
Week 1	0.02	[-0.04; 0.07]	0.04	[-0.03; 0.10]	0.23	[0.17; 0.29]	0.01	[-0.05; 0.06]	0.01	[-0.01; 0.02]	0.02	[-0.04; 0.07]	0.21	0.83	0.56
Week 2	0.15	[0.09; 0.21]	0.14	[0.08; 0.20]	0.24	[0.17; 0.31]	0.12	[0.06; 0.17]	0.03	[0.01; 0.05]	0.15	[0.09; 0.21]	0.80	0.43	0.22
Week 3	0.08	[0.02; 0.15]	0.32	[0.25; 0.32]	0.17	[0.10; 0.25]	0.03	[-0.04; 0.09]	0.06	[0.03; 0.08]	0.08	[0.02; 0.15]	1.24	0.21	0.67
Week 4	0.16	[0.09; 0.23]	0.42	[0.36; 0.48]	0.17	[0.10; 0.23]	0.09	[0.02; 0.16]	0.07	[0.04; 0.10]	0.16	[0.09; 0.23]	0.16	0.12	0.44
Week 5	0.19	[0.13; 0.26]	0.37	[0.31; 0.43]	0.20	[0.13; 0.28]	0.12	[0.05; 0.19]	0.08	[0.04; 0.11]	0.19	[0.13; 0.26]	1.51	0.13	0.40
Week 6	0.21	[0.15; 0.28]	0.43	[0.37; 0.49]	0.20	[0.12; 0.28]	0.13	[0.06; 0.19]	0.09	[0.05; 0.12]	0.21	[0.15; 0.28]	1.75	0.08	0.41
Week 7	0.19	[0.13; 0.26]	0.38	[0.32; 0.44]	0.30	[0.24; 0.36]	0.08	[0.01; 0.14]	0.11	[0.08; 0.14]	0.19	[0.12; 0.25]	2.48	0.01	0.60
Week 8	0.25	[0.18; 0.32]	0.37	[0.29; 0.45]	0.28	[0.20; 0.37]	0.15	[0.07; 0.22]	0.11	[0.07; 0.14]	0.25	[0.18; 0.32]	1.77	0.08	0.42
Week 9	0.27	[0.20; 0.34]	0.43	[0.36; 0.50]	0.26	[0.19; 0.33]	0.16	[0.09; 0.23]	0.11	[0.08; 0.15]	0.27	[0.20; 0.34]	1.97	0.05	0.41
Week 10	0.25	[0.13; 0.37]	0.30	[0.15; 0.46]	0.34	[0.22; 0.46]	0.15	[0.04; 0.27]	0.10	[0.04; 0.17]	0.26	[0.14; 0.38]	0.90	0.37	0.40
Phase 1	0.11	[0.07; 0.14]	0.16	[0.12; 0.20]	0.26	[0.22; 0.30]	0.06	[0.03; 0.10]	0.04	[0.03; 0.05]	0.11	[0.07; 0.14]	1.61	0.11	0.40
Phase 2	0.19	[0.15; 0.22]	0.41	[0.38; 0.44]	0.21	[0.17; 0.24]	0.10	[0.07; 0.14]	0.08	[0.07; 0.10]	0.19	[0.15; 0.22]	3.57	<0.001	0.45
Phase 3	0.24	[0.19; 0.28]	0.40	[0.35; 0.44]	0.28	[0.24; 0.33]	0.12	[0.08; 0.17]	0.11	[0.09; 0.13]	0.24	[0.19; 0.28]	3.24	0.00	0.48
Phase 4	0.25	[0.13; 0.37]	0.30	[0.15; 0.46]	0.34	[0.22; 0.46]	0.15	[0.04; 0.27]	0.10	[0.04; 0.17]	0.26	[0.14; 0.38]	0.90	0.37	0.40
Phase 5	0.20	[0.07; 0.34]	0.25	[0.10; 0.40]	0.33	[0.20; 0.46]	0.12	[0.00; 0.25]	0.08	[0.02; 0.14]	0.20	[0.07; 0.34]	0.75	0.45	0.40
Phase 6	0.20	[0.14; 0.27]	0.25	[0.19; 0.32]	0.34	[0.27; 0.41]	0.12	[0.05; 0.18]	0.09	[0.06; 0.12]	0.20	[0.14; 0.27]	1.78	0.07	0.43
Phase 7	0.34	[0.23; 0.44]	0.47	[0.37; 0.57]	0.43	[0.33; 0.52]	0.14	[0.03; 0.25]	0.20	[0.14; 0.26]	0.34	[0.23; 0.44]	2.58	0.01	0.59

c—total effect (credibility HPB), a—credibility alertness, b—alertness HPB, c'—direct effect, a*b—indirect effect, R—ratio direct/indirect effect.



behavioral responses of the population. The PCI, alertness, and protective behavior, be it actual or hypothetical, was generally rising during the first 3 weeks of the outbreak. Following that rise, alertness, PCI, and reported intention to engage in HPB then gradually decreased over the following weeks, which is in accordance with previous findings regarding psychological responses to an epidemic (e.g., Cheng and Cheung, 2005; Bangerter et al., 2012). However, the scales and rates of decreases varied from close to negligible (HPB) to sizable (alertness and PCI), and are not in close accordance with the number of infections or deaths in a given day. We have to note here, however, that the correlations were observed on a daily level, but the effect of spike in infections or deaths on other constructs could be delayed and might only result in changes after some time, and could not be fully accounted for using a cross-sectional approach. Regardless, the observed patterns of correlations suggest that indeed some other (psychological) factors may also be in play when considering people's responses to the epidemic.

Alertness reached its peak on March 23rd right after the police curfew was prolonged to 12 h, and remained fairly unchanged until March 29th. This is in accordance with previously observed early emotional responses to COVID-19, exhibiting an abrupt increase in negative emotional responses during the first few weeks of the epidemic (Wang et al., 2020). Following this date (March 29th) on which officials announced that the full lockdown might be introduced, the alertness dropped significantly. However, over this and the following few days the mobile subscribers received a text message sent by the National Crisis Headquarters urging them to stay home as "we are coming close to Spanish and Italian scenario." This was followed by a rapid increase in alertness scores. Although there were two more short-term spikes during the first half and the end of April, alertness was generally decreasing after the end of March, which is a pattern previously registered in studies on emotional responses to epidemics (e.g., Cheng and Cheung, 2005). By the 9th of May, the alertness was reduced to the level observed on the first day of the survey. During the second wave of infections, a similar pattern of changes was observed. In both cases, the observed spike in alertness occurred as the situation worsened, however it plateaued or started decreasing before the number of reported COVID-19 cases spiked in respective waves. This provides additional support for the robustness of the responses to the pandemic, and suggests the proposed psychological phases during the first wave of the epidemic could be mirrored to subsequent waves in terms of alertness.

Despite the obvious psychological pressure, the success of mitigating the spread of the infection depended on peoples' adherence to the measures. Our results indicate that evaluations of engagement in ASPB rose rapidly during the first 3 weeks, that is until the end of March, and remained at the consistent levels throughout the following 4 weeks. Actual self-protective behavior then decreased in the week from April 19th to 26th, which was during the last half of the Easter 84 h long police curfew, and simultaneously with announcements regarding the ease of protective and preventive measures and their actual waiving. However, the decrease in ASPB was then halted and mean scores remained stable until week 11. On the other hand,

regarding HPB, initial increase in reported intent to engage in protective behaviors during the first 3 weeks was followed by a decrease in the ratings until the end of the survey. Again, a remarkable drop in HPB was observed during the seventh week (longest lockdown period along with the announcements regarding weaving of measures).

In short, and in line with the previous findings regarding decrease in commitment to various protective behaviors (Lau et al., 2003; Cheng and Cheung, 2005; Karademas et al., 2013; Yeung et al., 2017), people were less ready to adhere to preventive and protective behaviors as the epidemic progressed. Moreover, contextual changes, such as easing of the state protective measures or not being able to leave home for more than 3 days seem to have induced decrease in adherence to both actual and intended behavior. Here, we stress that our data do not allow us to argue if the behavioral change was solely due to one contextual factor or the other, or their combination, and that the changes in adherence to protective behavior were gradual and of a small magnitude. While high adherence to protective behavior could be a result of effective communication and people's high motivation as proposed in literature (e.g., Lewandowsky et al., 2013; Van Bavel et al., 2020), it could also be attributed to strict measures enforced by the government, leaving people very little space for exercising their behavioral differences. It is worth noting, though, that at all time points, individual variability in reported measures was greater than population-level changes over time, suggesting that even if people are mandated to do so, the adherence to measures is influenced by the individual differences.

Perceived Credibility of Information

During an epidemic, public health authorities are expected to provide accurate information about the spread and effects of the outbreak in a timely manner (Tumpey et al., 2018; WHO, 2018). Aiming to persuade the citizens to change their behavior, it is important to note that the sources perceived as credible are also more persuasive (Petty and Brinol, 2008; O'Keefe, 2016). In the present study, PCI increased during the first 3 weeks, and following the peak, reached on March 24th, the PCI started to decrease. Ultimately, at the end of the data collection period in August, the registered mean evaluation of the PCI was even lower than at the beginning of the survey, which is in line with previous findings about the changing dynamic of people's trust in different sources of information during the outbreak of H1N1 in both China and in Switzerland (Bangerter et al., 2012; Yeung et al., 2017).

Moreover, at the end of March, the Serbian government announced centralization of authority over all information related to COVID-19 outbreak, and sent out the previously mentioned text message about the possible approaching of Spanish and Italian scenarios (see **Supplementary Table 1**). At the same time a journalist was arrested for publishing an alarming report on conditions in one of the health care centers. All the above was followed by a decrease in PCI scores. The lowest evaluations of PCI during the first wave were registered during week eight, between April 26th and May 2nd, when it was announced that the intensity of the state mandated measures will be significantly reduced (i.e., reopening of the majority of

small private-owned businesses). Taking these situational and contextual factors into account, it seems that the PCI might not only depend on the source expertise and trustworthiness (Van Bavel et al., 2020), but also on the consistency of the news delivered from different sources. Additionally, perceived reasonableness of the content of the information (e.g., removing state mandated measures abruptly) might have also undermined credibility. However, as we didn't include the measure of perceived reasonableness of the content of the information provided during the epidemic, such a conclusion is to be tested in future studies.

Promoting “Good” Behavior Through Information and Alertness

Besides observing the changes in PCI over time, we also focused on the role of PCI and its relation to intertwined both emotional and cognitive responses of the pandemic, as well as engagement in two forms of protective behavior. To test whether adherence to ASPB and HPB was related to the PCI and whether the relation is mediated by participants' alertness, we tested two mediation models, one for each type of behavior, in various time-periods. The models dubbed as CAB demonstrated relationship between PCI and ASPB was moderate and partly mediated by levels of alertness throughout the outbreak, which is in part supported by previous findings on importance of affective measures in promoting behavioral responses (Jones and Salathe, 2009; Liao et al., 2014). Moreover, as the total effect of PCI was gradually rising, the effect of alertness on ASPB remained fairly constant with the exception of a drop between weeks 1 and 2. This is consistent with some research on the role of cognitive measures (e.g., Liao et al., 2014), but inconsistent with observations by Leung et al. (2005a) who reported a drop in significance of affect-protective behavior link. Our findings might thus point to the fact that the alertness, as measured in the present study, might be more cognitive than an affective construct. Regardless, individual differences in alertness scores were a potent predictor of ASPB. Together with PCI, our mediational model accounted for nearly a half of variability in ASPB scores. This is especially noteworthy when accounting for relatively low degrees of freedom for people to exercise different behavior under state-mandated restrictions.

Furthermore, the cognitive nature of alertness may also be in accordance with a myriad of evidence suggesting that negative emotional arousal, although extensively used through fear appeals in campaigns aimed at inducing health related behavioral change, has limited and at times even counterproductive effects on behavior (Ruiter et al., 2014). On the contrary, *credible* information was also directly predicting ASPB throughout the epidemic, but especially when the epidemiological situation was better. This finding might be especially useful, as promoting protective behavior in those time periods is especially beneficial in preventing further outbreaks or mitigating their scale and unfolding. However, as some findings point to the fact that the positive effects of preventive measures such as social distancing and lockdown are only observed after 2–5 weeks after introduction (e.g., Cot et al., 2021), people need to consider the temporal focus in assessing the usefulness of the measures and choosing to adhere to them at present (e.g., Shipp and Aeon, 2019), which is not accounted for in our model. To improve

it, but also to improve the promotion of protective behavior, it would thus be useful to empirically account for whether people resort to future temporal focused in future studies, and to test how their temporal focus is linked with scores on alertness, PCI, or ASPB.

Similar patterns to those described for ASPB were also observed in the second CAB model, predicting HPB. There, the effect of PCI on alertness was also rising during the progression of the outbreak, while both the alertness-HPB and PCI-HPB remained relatively stable beyond the third week of measurement. Still, the share of explained variance of HPB was lower than in the first CAB model. This might be counter-intuitive, as HPM might be less influenced by state-mandated measures and thus both PCI and alertness might have stronger effects. However, the variability in mean scores of HPB was lower than in ASPB, possibly due to ceiling effect.

While the mediation model was stable starting from the third week of the outbreak, both direct and total effects were doubled from the acute to adaptation phase, suggesting that some time might be needed for people to adapt to the situation and for the relations between variables to be fully established. Furthermore, these observed changes confirm the plausibility of the notion that, though timely and focused credible informing of the public is non-disputable imperative during the whole course of the epidemics (Reynolds and Quinn Crouse, 2008; Reynolds and Seeger, 2014), those messages do not fall on the same psychological ground during different psychological phases of the epidemic. This means that credible sources could take into account stages of psychological response to pandemics in order to effectively communicate mitigation measures. If we only take the overall CAB model, based on all entries regardless of the psychological stage, we can miss important information about the dynamics of relationships between different variables of interest.

In terms of temporal changes in the predictive power of both CAB models, our results deviate slightly from similar study conducted during the first 100 h of the outbreak in Slovenia (Lep et al., 2020), where PCI was found to be significant even in the earliest hours of the outbreak, but still support the importance of credible information throughout the course of pandemic in order to elicit high adherence to protective behaviors. Our results further show support for continued monitoring of various variables throughout the extraordinary events. Again we stress here that pandemics are longer lasting and dynamic events, and it is not surprising that the relationships between variables were not the same at the end of the outbreak when people know the measures, and have experience with the virus, as they were initially when information relayed by the media could be conflicting and ever-changing, when people were adapting to living under lock-down, and trying to assess various aspects of danger.

CONCLUSIONS AND LIMITATIONS

One of the main contributions of the present study is the systematic monitoring of various psychological perceptions and responses throughout the whole epidemic situation in a given country. While some studies are available that aimed at monitoring the unfolding of the COVID-19 outbreak, present

study is the only one to our knowledge that comprises the whole duration of the state of the emergency in a single country and two full waves of the outbreak, thus offering information that expand on the findings of similar, albeit shorter studies on the dynamic of people's perceptions and responses (Sibley et al., 2020). Because we started gathering data only 2 days after the first confirmed case and continuing gathering until the end of official measures we had a unique opportunity to track changes in those perceptions and responses as well as their interplay. Such data thus offer a rich insight into what kind of interventions and support may be most useful in different stages of the outbreak. Moreover, as PCI not only proved to be an important predictor in mediation models in all stages of epidemic, but had increasingly stronger effect with the time passing, this suggests that effective communication is not only important in the early stages of the outbreak, but perhaps even more so once people's initial emotional reactions start to decrease. As PCI was relatively highly correlated with ASPB throughout the course of the epidemic, mean PCI scores were lowest after the first wave, when notable drops in ASPB were also observed. Lower ASPB scores could point to objectively lower risk when the epidemiological situation in Serbia improved, but there is no clear reason for PCI scores to drop at that time. In any similar situation in the future, it might thus be beneficial to ensure that PCI remains stable throughout the epidemic, and contributes to population wide adherence to protective measures.

As the study was conducted in Serbia, the results may not be easily generalized to other countries, especially because of the differences in applied governmental measures and people's perceived credibility of various sources. A caution is also warranted considering the *content* of credible information. Appeals to fear and alarming framing of the information might negatively influence one's awareness (Van den Bulck and Custers, 2009), while reassuring and solution oriented framing might have an opposite effect. All the while, both types of messages might be perceived as credible, which should be controlled for in future research when examining the role PCI has in changing alertness. However, as the dynamic of the observed variables was rather robust and generally in line with literature, we believe the findings on the role of PCI and individual changes in promoting protective behavior might translate to other contexts. The present study, however, only focused on the effects of official channels of pandemic related communication. In future studies, researchers should thus expand their scope and also tackle the potential effects of personal communications and the role of social networks in potential and actual behavior during the pandemic, and how they interact with the official discourse.

Our study also has some limitations in terms of sampling; as the data was collected online, the sample could be biased in terms of age and informational literacy, though it is of adequate range in terms of education of participants and the geographic distribution of population in the country. At the same time, the study design was cross-sectional and one should be cautious when making inferences from the results. As participants differed from day to day, presented results do not represent changes on the individual level, but rather capture broader changes in the society. Moreover, sample sizes varied

from day-to-day, but also in different time periods (as time progressed, the recruitment got harder). In later stages of the study, it is also likely that the survey attracted a somewhat biased population (e.g., those who were more worried, more interested in the topic). As the context of the study deviated significantly from normality, measures used were not validated beforehand, which could cause concern in terms of validity. However, measures were used beforehand in Slovenia, where they exhibited adequate psychometric characteristics (Lep et al., 2020), and were tested again to ensure their validity both in terms of culture and situation (various stages of the pandemic). Moreover, the tested model of the observed measures does not disclose any information about possible concurrent relations of these variables with other susceptibilities and conditions developed over the course of time in the first 161 days of epidemic in Serbia. The intensive dynamics of changes in collected data could have been partially shaped by the delayed or cumulated effects of the e.g., mental fatigue for alertness, changes in engagement in protective behaviors due to denial mechanism, wide spreading of conspiracy theories about COVID-19, or simply after recovering from the infection, or avoiding or the decrease of informing about epidemics for perceived credibility. Though this calls for caution in interpreting the results, the mediational model was relatively robust, which indicates that credible communication does indeed contribute to the both types of protective behaviors.

Finally, our research points to some potential areas of future research. As the pandemic on a global level is far from over at the time we write this, the dynamics of people's perceptions and responses in the post-pandemic stage remains to be explored. While our results point to the importance of effective communication when the situation is improving, the question remains as how to effectively communicate relevant information to people about loosening the official measures in a way people will still comply with recommendations about protective behavior and thus prevent further infection waves. In order to address the aforementioned shortcomings of the cross-sectional research approach using self-report questionnaires it could also be beneficial to triangulate different data types and techniques such as self-reports, big data (e.g., activity on social media, media use, data on purchases, and mobility), official records on the spread of the disease, mathematical models derived from such data, web scraping (media content), etc. This would allow to us to consider, for example, the content of the news people rated as more or less credible, and also to validate their reports (e.g., are the reported changes in behavior mirrored in actual behavior). This might be especially interesting as with passing time, people in our sample seem to have accepted the "new normal" and were less prepared to follow any official guidelines, but also less prepared to participate in this type of study, while the data remains crucial for researchers and officials alike. At the same time, anecdotal observations point to the rise of alternative facts, fake news, and conspiracy theories. The fight against misinformation and effective motivation thus remain great challenges for politicians and professionals of various expertise.

DATA AVAILABILITY STATEMENT

The analyzed datasets for this study will be uploaded in one of the open source repositories, upon the ending of the project *Psychological profile of pandemics in Serbia*.

ETHICS STATEMENT

All procedures performed in the study that involved human participants were reviewed and approved by the Ethics Commission of the Faculty of Arts, University of Ljubljana (no. 181-2020). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements. The study was conducted in accordance with the 1964 Helsinki declaration and its later amendments and comparable ethical standards.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

REFERENCES

- Alsam, M., and Wanamaker, M. (2018). Tuskegee and the health of black men. *Q. J. Econ.* 133, 407–455. doi: 10.1093/qje/qjx029
- Austin, L., Fisher Liu, B., and Jin, Y. (2012). How audiences seek out crisis information: exploring the social-mediated crisis communication model. *J. Appl. Commun. Res.* 40, 188–207. doi: 10.1080/00909882.2012.654498
- Bangerter, A., Krings, F., Mouton, A., Gilles, I., Green, E. G. T., and Clemence, A. (2012). Longitudinal investigation of public trust in institutions relative to the 2009 H1N1 pandemic in Switzerland. *PLoS ONE* 7:e49806. doi: 10.1371/journal.pone.0049806
- Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., and Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: the example of vaccination. *Health Psychol.* 26, 136–145. doi: 10.1037/0278-6133.26.2.136
- Brug, J., Aro, A. R., Oenema, A., De Zwart, O., Richardus, J. H., and Bishop, G. D. (2004). SARS risk perception, knowledge, precautions, and information sources, the Netherlands. *Emerg. Infect. Dis.* 10, 1486–1489. doi: 10.3201/eid1008.040283
- Cacciapaglia, G., Cot, C., and Sannino, F. (2020). Second wave COVID-19 pandemics in Europe: a temporal playbook. *Sci. Rep.* 10:15514. doi: 10.1038/s41598-020-72611-5
- Casagrande, M., Favieri, F., Tambelli, R., and Forte, G. (2020). The enemy who sealed the world: effects quarantine due to the COVID-19 on sleep quality, anxiety, and psychological distress in the Italian population. *Sleep Med.* 75, 12–20. doi: 10.1016/j.sleep.2020.05.011
- Chauhan, A., and Hughes, A. L. (2017). “Providing online crisis information: an analysis of official sources during the 2014 carlton complex wildfire,” in *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, CO), 3151–3162. doi: 10.1145/3025453.3025627
- Cheng, C., and Cheung, M. W. L. (2005). Psychological responses to outbreak of severe acute respiratory syndrome: a prospective, multiple time-point study. *J. Pers.* 73, 261–285. doi: 10.1111/j.1467-6494.2004.00310.x
- Cheung, C., and Tse, J. W. (2008). Institutional trust as a determinant of anxiety during the SARS crisis in Hong Kong. *Soc. Work Public Health* 23, 41–54. doi: 10.1080/19371910802053224

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.631791/full#supplementary-material>

- Cot, C., Cacciapaglia, G., and Sannino, F. (2021). Mining Google and Apple mobility data: temporal anatomy for COVID-19 social distancing. *Sci. Rep.* 11:4150. doi: 10.1038/s41598-021-83441-4
- Daly, M., and Robinson, E. (2020). Psychological distress and adaptation to the COVID-19 crisis in the United States. *J. Psychiatr. Res.* 136, 603–609. doi: 10.1016/j.jpsychires.2020.10.035
- ECDC (2020). *Download the Daily Number of New Reported Cases of COVID-19 by Country Worldwide*. European Centre for Disease Prevention and Control. Available online at: <https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide> (November 11, 2020).
- Erceg, N., Ružojčić, M., and Galic, Z. (2020). Misbehaving in the corona crisis: the role of anxiety and unfounded beliefs. *Curr. Psychol.* doi: 10.1007/s12144-020-01040-4. [Epub ahead of print].
- Ferrer, R., and Klein, W. M. (2015). Risk perceptions and health behavior. *Curr. Opin. Psychol.* 5, 85–89. doi: 10.1016/j.copsyc.2015.03.012
- Garcia de Avila, M. A., Hamamoto Filho, P. T., Jacob, F. L. D. S., Alcantara, L. R. S., Berghammer, M., Jenholt Nolbris, M., et al. (2020). Children’s anxiety and factors related to the COVID-19 Pandemic: an exploratory study using the children’s anxiety questionnaire and the numerical rating scale. *Int. J. Environ. Res. Public Health* 17:5757. doi: 10.3390/ijerph17165757
- Greyling, C., Maulit, J. A., Parry, S., Robinson, D., Smith, S., Street, A., et al. (2016). Lessons from the faith-driven response to the West Africa Ebola epidemic. *Rev. Faith Int. Aff.* 14, 118–123. doi: 10.1080/15570274.2016.1215829
- Jones, J. H., and Salathe, M. (2009). Early assessment of anxiety and behavioral response to novel swine-origin influenza A (H1N1). *PLoS ONE* 4: e8032. doi: 10.1371/journal.pone.0008032
- Jose, P. E. (2013). *Doing Statistical Mediation and Moderation*. New York, NY: Guilford Press.
- Karademas, E. C., Bati, A., Karkania, V., Georgiou, V., and Sofokleous, S. (2013). The association between pandemic influenza A (H1N1) public perceptions and reactions: a prospective study. *J. Health Psychol.* 18, 419–428. doi: 10.1177/1359105312436765
- Kavčič, T., Avsec, A., and Zager Kocjan, G. (2020). Psychological functioning of Slovene adults during the COVID-19 pandemic: does resilience matter? *Psychiatr Q.* doi: 10.1007/s1126-020-09789-4
- Kiviniemi, M. T., Ellis, E. M., Hall, M. G., Moss, J. L., Lillie, S. E., Brewer, N. T., et al. (2018). Mediation, moderation, and context: understanding complex

- relations among cognition, affect, and health behavior. *Psychol. Health* 33, 98–116. doi: 10.1080/08870446.2017.1324973
- Lau, J. T. F., Tsui, H. Y., Kim, J. H., Chan, P. K. S., and Griffiths, S. (2010). Monitoring of perceptions, anticipated behavioral, and psychological responses related to H5N1 influenza. *Infection* 38, 275–283. doi: 10.1007/s15010-010-0034-z
- Lau, J. T. F., Yang, X., Tsui, H., and Kim, J. H. (2003). Monitoring community responses to the SARS epidemic in Hong Kong: from day 10 to day 62. *J. Epidemiology Community Health* 57, 864–870. doi: 10.1136/jech.57.11.864
- Lee, I. A., and Preacher, K. J. (2013). *Calculation for the Test of the Difference Between Two Dependent Correlations With One Variable in Common [Computer Software]*. Available online at: <http://quantpsy.org> (accessed October 12, 2020).
- Lep, Ž., Babnik, K., and Hacin-Beyazoglu, K. (2020). Emotional responses and self-protective behavior within days of the COVID-19 outbreak: the promoting role of information credibility. *Front. Psychol.* 11:1846. doi: 10.3389/fpsyg.2020.01846
- Leung, G. M., Ho, L. M., Chan, S. K., Ho, S. Y., Bacon-Shone, J., Choy, R. Y., et al. (2005a). Longitudinal assessment of community psychobehavioral responses during and after the 2003 outbreak of severe acute respiratory syndrome in Hong Kong. *Clin. Infect. Dis.* 40, 1713–1720. doi: 10.1086/429923
- Leung, G. M., Lam, T. H., Ho, L. M., Ho, S. Y., Chan, B. H. Y., Wong, I. O. L., et al. (2005b). The impact of community, psychological responses on outbreak control for severe acute respiratory syndrome in Hong Kong. *J. Epidemiology Community Health* 57, 857–863. doi: 10.1136/jech.57.11.857
- Lewandowsky, S., Gignac, G. E., and Vaughan, S. (2013). The pivotal role of perceived scientific consensus in acceptance of science. *Nat. Clim. Chang.* 3, 399–404. doi: 10.1038/NCLIMATE1720
- Li, J. B., Yang, A., Dou, K., Wang, L.-X., Zhang, M.-C., and Lin, X. (2020). Chinese public's knowledge, perceived severity, and perceived controllability of the COVID-19 and their associations with emotional and behavioural reactions, social participation, and precautionary behaviour: a national survey. *PsyArXiv Preprints*. doi: 10.31234/osf.io/5tmsh
- Liao, Q., Cowling, B., Lam, W. T., Ng, M. W., and Fielding, R. (2010). Situational awareness and health protective responses to pandemic influenza A (H1N1) in Hong Kong: a cross-sectional study. *PLoS One* 5:e13350. doi: 10.1371/journal.pone.0013350
- Liao, Q., Cowling, B. J., Lam, W. W., Ng, D. M., and Fielding, R. (2014). Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional surveys. *BMC Infect. Dis.* 14:169. doi: 10.1186/1471-2334-14-169
- MHCC (2012). *Mental Health Coordinating Council 2012, MHCC Organisation Builder (MOB) - Policy Resource, Sydney, Australia*. Available online at: www.mob.mhcc.org.au (accessed June 20, 2020).
- Moghanibashi-Mansourieh, A. (2020). Assessing the anxiety level of Iranian general population during COVID-19 outbreak. *Asian J. Psychiatr.* 51:102076. doi: 10.1016/j.ajp.2020.102076
- OECD (2020). *Flattening the COVID-19 Peak: Containment and Mitigation Policies. OECD Policy Responses to Coronavirus (COVID-19)*. Available online at: <https://www.oecd.org/coronavirus/policy-responses/flattening-the-covid-19-peak-containment-and-mitigation-policies-e96a4226/> (accessed September 13, 2020).
- O'Keefe, D. J. (2016). *Persuasion: Theory and Research*. Thousand Oaks, CA: Sage.
- Özdin, S., and Bayrak Özdin, S. (2020). Levels and predictors of anxiety, depression and health anxiety during COVID-19 pandemic in Turkish society: the importance of gender. *Int. J. Soc. Psychiatry* 66, 504–511. doi: 10.1177/0020764020927051
- Parvin, G. A., Ahsan, R., Rahman, M. H., and Abedin, M. A. (2020). Novel coronavirus (COVID-19) pandemic: the role of printing media in Asian countries. *Front. Commun.* 5:557593. doi: 10.3389/fcomm.2020.557593
- Petty, R. E., and Brinol, P. (2008). Persuasion: from single to multiple to metacognitive processes. *Perspect. Psychol. Sci.* 3, 137–147. doi: 10.1111/j.1745-6916.2008.00071.x
- Petzold, M. B., Bendau, A., Plag, J., Pyrkosch, L., Mascarell Maricic, L., Betzler, F., et al. (2020). Risk, resilience, psychological distress, and anxiety at the beginning of the COVID-19 pandemic in Germany. *Brain Behav.* 10:e01745. doi: 10.1002/brb3.1745
- Reynolds, B., and Quinn Crouse, S. (2008). Effective communication during an influenza pandemic: the value of using a crisis and emergency risk communication framework. *Health Promot. Pract.* 9(4 Suppl), 13S–17S. doi: 10.1177/1524839908325267
- Reynolds, B., and Seeger, M. (2014). *Crisis and Emergency Risk Communication, 2014 Edn.* Centers for Disease control and Prevention. Available online at: https://emergency.cdc.gov/cerc/resources/pdf/cerc_2014edition.pdf (accessed October 18, 2020).
- Rosseel, Y. (2012). lavaan: an R package for structural equation modeling. *J. Stat. Softw.* 48, 1–36. doi: 10.18637/jss.v048.i02
- Ruiter, R. A., Kessels, L. T., Peters, G. J. Y., and Kok, G. (2014). Sixty years of fear appeal research: current state of the evidence. *Int. J. Psychol.* 49, 63–70. doi: 10.1002/ijop.12042
- Sandman, P. M. (2009). Pandemics: good hygiene is not enough. *Nature* 459, 322–323. doi: 10.1038/459322a
- Selye, H. (1946). The general adaptation syndrome and the diseases of adaptation. *J. Clin. Endocrinol. Metab.* 6, 117–230.
- Sherlaw, W., and Raude, J. (2013). Why the French did not choose to panic: a dynamic analysis of the public response to the influenza pandemic. *Sociol. Health Illn.* 35, 332–344. doi: 10.1111/j.1467-9566.2012.01525.x
- Shevlin, M., McBride, O., Murphy, J., Miller, J., Hartman, T., Levita, L., et al. (2020). Anxiety, depression, traumatic stress and COVID-19-related anxiety in the UK general population during the COVID-19 pandemic. *BJPsych Open* 6:E125. doi: 10.1192/bjo.2020.109
- Shiina, A., Niitsu, T., Kobori, O., Idemoto, K., Hashimoto, T., Sasaki, T., et al. (2020). Relationship between perception and anxiety about COVID-19 infection and risk behaviors for spreading infection: a national survey in Japan. *Brain Behav. Immun-Health* 6:100101. doi: 10.1016/j.bbih.2020.100101
- Shipp, A. J., and Aeon, B. (2019). Temporal focus: thinking about the past, present, and future. *Curr Opin Psychol.* 26, 37–43. doi: 10.1016/j.copsy.2018.04.005
- Sibley, C. G., Greaves, L. M., Satherley, N., Wilson, M. S., Overall, N. C., Lee, C. H. J., et al. (2020). Effects of the COVID-19 pandemic and nationwide lockdown on trust, attitudes toward government, and well-being. *Am. Psychol.* 75, 618–630. <http://10.1037/amp0000662>
- The Lancet (2020). Editorial. COVID-19: fighting panic with information. *Lancet* 395:537. doi: 10.1016/S0140-6736(20)30379-2
- Theorell, T., Westerlund, H., Alfredsson, L., and Oxenstierna, G. (2005). Coping with critical life events and lack of control—the exertion of control. *Psychoneuroendocrinology* 30, 1027–1032. doi: 10.1016/j.psyneuen.2005.03.015
- Tumpey, A. J., Daigle, D., and Nowak, G. (2018). “Communicating During an outbreak or public health investigation,” in *The CDC Field Epidemiology Manual*, eds S. A. Rasmussen and R. A. Goodman (New York, NY: Oxford University Press).
- Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., et al. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nat. Hum. Behav.* 4, 460–471. doi: 10.1038/s41562-020-0884-z
- Van den Bulck, J., and Custers, K. (2009). Television exposure is related to fear of avian flu, an ecological study across 23 member states of the European Union. *Eur. J. Public Health* 19, 370–374. doi: 10.1093/eurpub/ckp061
- Vijaykumar, S., Nowak, G., Himelboim, I., and Jin, Y. (2018). Virtual Zika transmission after the first U.S. case: who said what and how it spread on Twitter. *Am. J. Infect. Control.* 46, 549–557. doi: 10.1016/j.ajic.2017.10.015
- Vinck, P., Pham, P. N., Bindu, K. K., Bedford, J., and Nilles, E. J. (2019). Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *Lancet Infect. Dis.* 19, 529–536. doi: 10.1016/s1473-3099(19)30063-5
- Wakefield, M. A., Loken, B., and Hornik, R. C. (2010). Use of mass media campaigns to change health behaviour. *Lancet* 376, 1261–1271. doi: 10.1016/s0140-6736(10)60809-4
- Wang, H., Xia, Q., Xiong, Z., Li, Z., Xiang, W., Yuan, Y., et al. (2020). The psychological distress and coping styles in the early stages of the 2019 coronavirus disease (COVID-19) epidemic in the general mainland Chinese population: a web-based survey. *PLoS ONE* 15:e0233410. doi: 10.1371/journal.pone.0233410
- WHO (2008). *Outbreak Communication Planning Guide*. Available online at: <http://www.who.int/ihr/elibrary/WHOOutbreakCommsPlanngGuide.pdf> (accessed September 13, 2020).
- WHO (2018). *Managing epidemics: key facts about major deadly diseases*. Geneva: World Health Organization. Available online at: <https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf> (accessed September 13, 2020).
- Yeung, N. C. Y., Lau, J. T. F., Choi, K. C., and Griffiths, S. (2017). Population responses during the pandemic phase of

the influenza A(H1N1)pdm09 epidemic, Hong Kong, China. *Emerging Infect. Dis.* 23, 813–815. doi: 10.3201/eid2305.160768

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Analytic Thinking and Political Orientation in the Corona Crisis

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With much unknown about the new coronavirus, the scientific consensus is that human hosts are crucial to its spread and reproduction—the more people behave like regular socializing beings they are, the more likely it is that the virus will propagate. Hence, many nations worldwide have mandated physical-distancing measures. In the current preregistered research, we focus on examining two factors that may help explain differences in adherence to COVID-19 preventive behaviors and policy support across different countries—political orientation and analytic thinking. We positioned our research within the dual-process framework of human reasoning and investigated the role of cognitive reflection, open-minded thinking, and political ideology in determining COVID-19 responsible behavior (physical distancing and maintaining hygiene) and support for restrictive COVID-19 policies on a sample of 12,490 participants from 17 countries. We have not been able to detect substantial relationships of political orientation with preventive behaviors and policy support, and overall found no reliable evidence of politicization, nor polarization regarding the issue. The results of structural equation modeling showed that the inclination towards COVID-19 preventive measures and their endorsement were defined primarily by the tendency of open-minded thinking. Specifically, open-minded thinking was shown to be a predictor of all three criteria—avoiding physical contact, maintaining physical hygiene, and supporting COVID-19 restrictive mitigation policies. Cognitive reflection was predictive of lesser adherence to stricter hygiene and only very weakly predictive of lesser policy support. Furthermore, there was no evidence of these effects varying across political contexts. The mediation analysis suggested a partial mediation effect of COVID-19 conspiracy beliefs on the relationships of open-mindedness and cognitive reflection with physical distancing (but not adherence to stricter hygiene) and COVID-19 policy support, albeit very small and significant primarily due to sample size. There was also no evidence of these effects varying across political contexts. Finally, we have not been able to find strong evidence of political orientation modifying the relationship between analytical thinking and COVID-19 behaviors and policy support, although we explored the pattern of these effects in the US and Canadian samples for exploratory purposes and comparison with other similar studies.

Keywords: COVID-19, open-minded thinking, cognitive reflection, political orientation, preventive behavior, policy support, conspiracy beliefs, cross-national

INTRODUCTION

Public Response to the COVID-19 Pandemic—Preventive Behaviors and Policy Support

The COVID-19 pandemic is a global health crisis affecting all major aspects of human life—political, social, economic, and psychological. Given the lack of any clinically approved antiviral drugs or vaccines at the time when our survey was conducted, the only way of mitigating and controlling the spread of the novel coronavirus was to break the chain of infection. Thus, responsible preventive behaviors guided by reliable information were paramount in combating COVID-19. However, public health response is not uniform, and preventive measures, such as physical distancing, self-isolating, and maintaining good hygiene, can hardly be implemented by coercion alone. Citizens need to understand what is required of them and realize the importance of complying.

Various preventive behaviors against COVID-19 have been identified and advised, such as those summarized by the World Health Organization (2021). Many have been promoted by relevant public health officials and bodies in most countries and incorporated in their COVID-19 policies. Generally, preventive behaviors can be broadly categorized into two types: spatial distancing and stricter hygiene. Although many studies (e.g., Alper et al., 2020; Harper et al., 2020; Plohl and Musil, 2020; Qian and Yahara, 2020; Raude et al., 2020) used composite measures of multiple types of preventive behaviors, several studies demonstrated that spatial distancing and stricter hygiene represent distinct types of preventive behaviors with different correlates (Wismans et al., 2020; van Mulukom et al., 2021).

In addition to these universally advocated preventive behaviors, almost all countries have implemented some type of COVID-19 restrictive policy, ranging from advising work from home to governments enacting full lockdowns. Investigating public support for imposing different restrictions that limit some of the fundamental civil rights for the collective good should provide valuable information. A better understanding of public response is vital for modeling the course of a pandemic and appropriate public health communication. Indeed, epidemiological research has acknowledged the weakness of many traditional mathematical models of infectious diseases in that they generally do not allow for behavioral heterogeneity, which inevitably limits their accuracy and predictive validity (Weston et al., 2018).

Like any behavior, such behavior change is presumed to be influenced by numerous individual, interpersonal, societal, and ecological factors. Research conducted both before (Bish and Michie, 2010; Lunn et al., 2020) and during (e.g., Clark et al., 2020; Earnshaw et al., 2020; Harper et al., 2020; Sabat et al., 2020) this pandemic has explored various sociodemographic, psychological, and contextual determinants of engaging in preventive behavior and support for official public health policies. Although the current crisis sparked the proliferation of social and behavioral science research, much is still unknown about how people respond to the COVID-19 pandemic, including the causes and motives of engaging in health-protective behaviors.

The COVID-19 pandemic is a public health and policy issue, but also a scientific issue, and there is a wide range of factors at play in reasoning about it. Communicating complex medical and scientific concepts to the public is difficult enough without conflicting or unclear messages from government officials and public health advisors, with an abundance of misinformation in the media adding to this complexity. Thus, reasoning and judgment are done in the highly uncertain context of a global pandemic and infodemic, bearing significant psychological loads on individuals.

With regard to the aforementioned, we sought to contribute to social and behavioral science efforts by taking the cognitive science lens to investigate psychological determinants of COVID-19 preventive behavior and policy support, focusing on the role of reasoning and political ideology. Specifically, we positioned our research within the dual-process framework of human reasoning, examining the postulates of classical reasoning account and identity-protective cognition account.

Theoretical Framework—Analytic Thinking Within the Dual-Process Framework of Human Reasoning

The fundamental idea within the influential dual-process framework is that there are two qualitatively different types of processing—autonomous, intuitive (Type 1) processing and typically deliberative and computationally demanding (Type 2) processing achieved by some form of deliberative control (Evans and Stanovich, 2013; Pennycook et al., 2015c). With heavy loading on working memory resources, Type 2 processing is computationally expensive. Consequently, humans often act as “cognitive misers,” typically seeking to avoid resource-demanding processes and defaulting to processing mechanisms of low computational expense (e.g., Kahneman, 2011; Stanovich, 2015). In fact, processing outcomes of both types are often consistent, and, in such cases, heuristic mechanisms of low computational cost are very efficient (Kahneman, 2011; Stanovich et al., 2016). However, they can also result in very different and conflicting outcomes. Because Type 1 processing has not evolved for the fine-grained, deep analysis required by many situations of the modern world, in such cases, a propensity for analytical, computationally demanding thinking may be crucial (Stanovich, 2012). Indeed, in the dual-process literature, conflict detection, and an override of incorrect autonomous responses are deemed as fundamental functions of analytic processing (Evans and Frankish, 2009; Pennycook et al., 2015c; Stanovich et al., 2016).

Classical Reasoning Perspective

From the “classical reasoning” or “reflectionist” perspective (see Pennycook, 2018) deliberative, analytic thinking is viewed to support rational thinking, reasoning, and decision making by overriding incorrect intuitive responses (Pennycook et al., 2015c; Stanovich et al., 2016; for a review of conflict detection in reasoning, see De Neys, 2014). Moreover, a crucial finding within the dual-process framework is that, to think rationally, one has to have the adequate *computational capacity* (i.e., cognitive ability, intelligence) to respond to the processing requirements

and the *willingness to engage deliberative reasoning processes* (i.e., thinking dispositions that foster thorough and prudent, unbiased thought, and knowledge acquisition) (Stanovich and West, 2000; Stanovich, 2011; Pennycook et al., 2015c).

Within the dual-process framework, numerous measures have been used as indicators of analytic or rational thinking (see for example, Stanovich et al., 2016). Some of the more commonly used are different versions of the cognitive reflection test and open-minded thinking scale (for a review, see Stanovich et al., 2016).

The *cognitive reflection test* (CRT) was originally designed to measure the ability or disposition to override a predominant intuitive but incorrect response and to engage in further reflection, leading to the correct response (Frederick, 2005). As such, it is assumed to represent a prime measure of overcoming miserly processing, proposed by authors, most prominently by Stanovich et al. (2016). It is one of the most widely used measures of the propensity to engage in analytic thinking and has proved to be a potent predictor of performance on various kinds of reasoning (e.g., Lesage et al., 2013; Sirota et al., 2014; Pennycook et al., 2017) and decision-making tasks (e.g., Frederick, 2005; Cokely and Kelley, 2009; Oechssler et al., 2009; Koehler and James, 2010; Hoppe and Kusterer, 2011), with its predictive effect proven stronger than intelligence and executive functioning measures on a wide range of these tasks (Toplak et al., 2011, 2014; see also Trippas et al., 2015). Moreover, cognitive reflection has been associated with a broad range of beliefs and behaviors in everyday life, such as paranormal disbelief, utilitarian moral judgment, science understanding, and smartphone use, to name a few (see Pennycook et al., 2015b for a review). In fact, its predictive potency may derive from the fact that it happens to tap both aspects of Type 2 processing—the ability and disposition to engage in analytic thinking (Toplak et al., 2011; Campitelli and Gerrans, 2014; Pennycook and Ross, 2016; but see also Szaszi et al., 2017; Erceg et al., 2020a for a further discussion).

The dispositional tendency of actively open-minded thinking is one of the thinking dispositions deemed specifically relevant to rational thinking (Baron, 1985, 2019; Stanovich et al., 2016). Unlike the CRT, a primarily maximal performance measure, *open-minded thinking* is a self-reported measure of the tendency of recognizing the limitations of one's own knowledge (especially in relation to others) and openness to new information and knowledge as opposed to arrogance about one's own knowledge and intellectual abilities (Alfano et al., 2017). Thus, it is a (typical performance) indicator of the willingness to initiate an override and engage deliberative reasoning processes. It should be mentioned that there are different versions of the scales intended to measure the tendency of open-minded thinking (comprising different dimensions of the construct), which vary between six, seven (e.g., Haran et al., 2013; Alfano et al., 2017), up to 41 items (Stanovich and West, 2007).

Research shows that the two indicators of analytic thinking, CRT, and open-mindedness, are positively correlated, typically in the range 0.2–0.3 (Haran et al., 2013; Toplak et al., 2014; Szaszi et al., 2017; Svedholm-Häkkinen and Lindeman, 2018; Bronstein et al., 2019; McPhetres et al., 2021). Similar to CRT, open-mindedness is associated with lower susceptibility to biases

in reasoning and decision-making tasks (e.g., Sá et al., 1999; West et al., 2008; Toplak et al., 2011; Heijltjes et al., 2014; Svedholm-Häkkinen and Lindeman, 2018).

Moreover, a growing body of evidence has linked these two as well as other indicators of analytic reasoning with various beneficial psychological and behavioral outcomes. For example, analytic, cognitively sophisticated individuals exhibit more discerning social media use (Mosleh et al., 2021); they are less prone to various unfounded, epistemically suspect beliefs (Pennycook et al., 2015b), the so-called pseudo-profound bullshit (Pennycook et al., 2015a), and fake news (Bronstein et al., 2019; Pennycook and Rand, 2019), as well as religious beliefs (Pennycook et al., 2014, 2020a). There is also some evidence suggesting that activation of analytic thinking can lead to a higher endorsement of (some domains of) secular belief (Hudiyana et al., 2019). In addition, recent research has indicated that individuals more prone to analytic thinking are also more likely to form or adhere to scientifically founded beliefs (Pennycook et al., 2020a; McPhetres et al., 2021).

Individual differences in analytic thinking are also reflected in the health domain, specifically health-related attitudes and behaviors. Analytically sophisticated individuals (i.e., those characterized by higher cognitive reflection and open-mindedness) are generally less inclined to complementary and alternative forms of medical treatment and to believe in their effectiveness (Browne et al., 2015; Svedholm-Häkkinen and Lindeman, 2018; McPhetres et al., 2021).

Initial findings on the relationship between different indicators of analytic thinking and responsible behaviors in the context of COVID-19 are somewhat mixed.

Regarding the role of cognitive reflection, while some researchers found a negative predictive effect of cognitive reflection on preventive behavior (Thoma et al., 2021), others found a negative effect of cognitive intuition on responsible behavior (Teovanović et al., 2021), yet others did not detect an effect (although it negatively predicted conspiracy beliefs; Alper et al., 2020) or showed that the effect of cognitive reflection is fully mediated by unfounded beliefs (Erceg et al., 2020b; Stanley et al., 2020).

As for open-minded thinking, Thoma et al. (2021) found it did not predict reported preventive behavior, but the results of Erceg et al. (2020b) indicate that the effect of actively open-minded thinking on responsible behavior is mediated by unfounded beliefs.

Here, we present the results in more detail.

Erceg et al. (2020b) used several indicators of analytic thinking, i.e., the CRT and three thinking dispositions—actively open-minded thinking, faith in intuition, and science curiosity. Zero-order correlations showed that cognitive reflection, actively open-minded thinking, and science curiosity were associated with less unfounded COVID-19 beliefs and higher knowledge. Conversely, faith in intuition was related to more unfounded beliefs and worse COVID-19 knowledge. Furthermore, out of the aforementioned variables, only actively open-minded thinking and science curiosity were associated with responsible behavior (avoiding physical contact, washing hands, avoiding going out, and coughing and sneezing in the elbow). Within an SEM

model, among those variables, only science curiosity emerged as a direct predictor of COVID-19 responsible behavior once other measures were controlled for. Additionally, the authors found that faith in intuition positively and cognitive reflection and actively open-minded thinking negatively predicted COVID-19 unfounded beliefs, while the effect of science curiosity was non-significant. Moreover, unfounded beliefs predicted less responsible behavior and mediated the effects of cognitive reflection, actively open-minded thinking, and faith in intuition on responsible behavior.

Alper et al. (2020) found that higher faith in intuition, generic conspiracy beliefs, and a lower level of cognitive reflection predicted COVID-19 conspiracy beliefs. On the other hand, they did not detect the predictive effects of any of these variables on adherence to preventive measures.

Thoma et al. (2021) found that tendency toward cognitive failures (a self-report measure of the tendency of lapses of attention, memory, and cognition in everyday life) and actively open-minded thinking did not predict reported preventive behavior. Lower understanding of the infection and transmission mechanism of COVID-19, a higher risk-taking tendency and higher cognitive reflection predicted adopting fewer preventive behaviors while more concern predicted adopting more of the preventive behaviors.

Teovanović et al. (2021) found that, in addition to COVID-19 conspiracy beliefs predicting engaging in pseudoscientific practices, lower adherence to COVID-19 guidelines, and unwillingness to get vaccinated, cognitive intuition (calculated as a mean of intuitive responses on the CRT) predicted only lesser adherence to COVID-19 guidelines. Furthermore, overestimation of COVID-19-related knowledge predicted lesser adherence to COVID-19 guidelines but also lesser engagement in pseudoscientific practices, while cognitive biases predicted greater use of pseudoscientific practices but also greater adherence to COVID-19 guidelines and willingness to get vaccinated.

Stanley et al. (2020) found significant indirect effects of CRT performance on distancing and hand-washing behaviors, with cognitively reflective individuals being more likely to believe the pandemic was a hoax and consequently less likely to engage in distancing and hand-washing behaviors. In addition, CRT did not exhibit any direct effects on physical distancing and handwashing.

Swami and Barron (2020) also tested and confirmed a mediation model in which conspiracy beliefs mediated the relationship between analytic thinking (indexed by scores on the analytic thinking subscale of the Rational/Experiential Multimodal Inventory) and compliance with mandated distancing measures. Specifically, they found that greater analytic thinking was directly associated with physical distancing behavior that was mandated in the UK in early April 2020, as well as indirectly *via* lower COVID-19 conspiracy beliefs.

When considering these results, one has to keep in mind that the studies were conducted in March and April 2020 in different countries during the first wave of the COVID-19 pandemic. Thus, some of the differences in the findings between studies may be due to differences in the specific policies and

restrictions in place at the time of data collection. To sum up, despite somewhat mixed results, a few of the studies provide evidence that the relationship between analytical thinking and COVID-19 preventive behavior or intentions could be explained by COVID-19 conspiracy beliefs (Stanley et al., 2020; Swami and Barron, 2020) and similar unfounded beliefs (Erceg et al., 2020b). Such links between COVID-19 conspiracy beliefs and cognitive processing are in line with previous findings on the importance of cognitive factors in explaining conspiracy beliefs in general, with different indicators of cognitive proficiency being generally associated with reduced conspiratorial ideation (Oliver and Wood, 2014a,b; Swami et al., 2014, 2017; Stanovich et al., 2016; Van Prooijen, 2017; Georgiou et al., 2019). We further outline the role of conspiracy beliefs within the dual-process framework in the following section.

Conspiracy Beliefs as Contaminated Mindware

In addition to adequate computational power and willingness to engage deliberative reasoning processes, Stanovich et al. (2016) stress that procedural and declarative knowledge is required for successful Type 2 override. Stanovich (e.g., Stanovich, 2011; Stanovich et al., 2016) adopted the term “mindware” to refer to these knowledge structures, strategies, rules, and belief bases. However, various thinking problems can arise related to mindware—even if the first two prerequisites are satisfied, lack, or inaccessibility of appropriate mindware, or having one that is contaminated can inhibit reasoning processes and hinder rational thought (Stanovich et al., 2016).

The tendency toward conspiracy beliefs generally reflects the inclination of an individual to attribute the causes of various events or phenomena to conspiracies secretly plotted by individuals or groups of powerful people with predominantly sinister intentions (Douglas and Sutton, 2008; Bruder et al., 2013). Although some conspiracies may turn out to be true, they generally lack evidential support and resist falsification (Sutton and Douglas, 2014). Quintessentially, conspiracy beliefs bear the “unnecessary assumption of conspiracy when other explanations are more probable” (Aronovitch, 2009, p. 5) and represent an important domain of *contaminated mindware* (Stanovich et al., 2016; Rizeq et al., 2021).

It has been well-documented that endorsement of specific conspiracy theories is associated with greater beliefs in other conspiracy theories (Goertzel, 1994; Swami et al., 2010; Lewandowsky et al., 2013; Majima, 2015), even when conspiracy theories themselves are contradictory (Wood et al., 2012). This speaks to the notion of a general disposition toward conspiracist ideation, i.e., a conspiracy mentality (Imhoff and Bruder, 2014). As an explanation of the pervasiveness of conspiratorial thinking and the allure of various conspiracy theories, Oliver and Wood (2014a) postulated two psychological predispositions underlying conspiratorial ideation – attributing intentionality to unseen others and the tendency for melodramatic narratives when faced with important events that require explanation. These resonate well with the proposed “fundamental computational biases” of Stanovich in human cognition (Stanovich, 2003), specifically with the human proclivity to infer intentionality and to rely on a narrative mode of thought.

Not surprisingly, the rapid spread of the COVID-19 and the global crisis produced laid fertile ground for the mass proliferation of various COVID-19-related conspiracies. In the state of global emergency, adverse outcomes beyond an individual, such as vaccination resistance that can lead to devastating collective consequences, are particularly worrying. Indeed, previous research suggested that conspiracy beliefs are related to unwarranted health behavior, such as vaccination refusal, medical treatment non-adherence, and alternative medicine use (Bogart et al., 2010; Grebe and Natrass, 2012; Jolley and Douglas, 2014; Oliver and Wood, 2014b). Furthermore, initial evidence in the context of the COVID-19 pandemic suggests that belief in conspiracy theories undermines engagement in preventive behaviors and support for public health policies (Erceg et al., 2020b; Imhoff and Lamberty, 2020; Plohl and Musil, 2020; Stanley et al., 2020; Swami and Barron, 2020; Pavela Banai et al., 2021). However, Alper et al. (2020) did not find any evidence of the association between COVID-19 conspiracy beliefs and preventive measures. In fact, a recent systematic review (van Mulukom et al., 2021) has revealed that the type of preventive behavior measure matters. In the case of general measures of preventive behavior (measures that combine hygiene, distancing, and/or mask-wearing), COVID conspiracy beliefs were negatively associated with self-reported adherence to behavioral guidelines in most studies and across different countries. However, in the case of separate measures of hygiene and distancing, studies from the USA and Europe mainly (although not all) indicate a negative association of conspiracy beliefs (general or COVID-19) with distancing but not with hygiene guidelines (van Mulukom et al., 2021). Longitudinal studies also point to similar findings. Bierwiazzonek et al. (2020) found that overall conspiracy beliefs generally decreased, and distancing behavior increased over time, with individuals endorsing more conspiracy beliefs at the beginning of the crisis, exhibiting the lowest increase of distancing behavior. Pummerer et al. (2021) detected the adverse effect of conspiracy beliefs on distancing, but not hygiene behaviors. Inevitably, this issue warrants further investigation.

Theoretically and empirically, computational power, willingness to engage deliberative reasoning processes, and mindware are unavoidably intertwined (Stanovich et al., 2016). With regard to the indicators of analytic thinking, the presence of contaminated conspiratorial mindware has been shown to correlate negatively (weak to moderate correlations) with cognitive reflection (Stanovich et al., 2016; Van Prooijen, 2017; Pennycook et al., 2020a) and open-mindedness (Swami et al., 2014; Stanovich et al., 2016; Pennycook et al., 2020a). In the context of the coronavirus pandemic, initial findings confirm that analytically sophisticated individuals are less prone to believe various misinformation and pseudoscientific practices regarding coronavirus prevention and treatment, including fake news and conspiracy theories about its nature and origin (Alper et al., 2020; Čavojeva et al., 2020; Erceg et al., 2020b; Pennycook et al., 2020b, 2021; Stanley et al., 2020; Teovanović et al., 2021). Furthermore, indicators of analytic thinking have shown to be significant and relatively strong negative predictors of various misperceptions and unfounded beliefs and knowledge about

COVID-19 (Čavojeva et al., 2020; Erceg et al., 2020b; Stanley et al., 2020; Swami and Barron, 2020; Pennycook et al., 2021). Overall, described patterns of associations between analytic thinking, conspiracy beliefs, and COVID-19 protective behavior further suggest the possibility of endorsement of conspiracy beliefs mediating the negative relation between analytic thinking and responsible behavior. However, such a hypothesis has been investigated and confirmed only in a few studies and warrants further research (Erceg et al., 2020b; Stanley et al., 2020; Swami and Barron, 2020).

Motivated Reasoning—A Case for Politicization of the Crisis

In addition to being cognitive misers, humans are also “motivated reasoners” in the sense that they perceive and process information directed by certain motives or goals (Kunda, 1990; Taber and Lodge, 2006; Leeper and Slothuus, 2014). More often than not, our reasoning is directed by some goals other than accuracy (Kunda, 1990; Taber and Lodge, 2006). Namely, we are often motivated to maintain and support our existing conceptions and beliefs using any of the many processes by which we explain new inconsistent information we encounter, which is in contrast to the classical notions of rational updating (Kunda, 1990; Taber and Lodge, 2006).

Some of the most common sources of directional motivated reasoning are political ideology and partisanship, and issue-related prior opinions (Taber and Lodge, 2006; Bolsen et al., 2014; Leeper and Slothuus, 2014). Indeed, in Western societies (primarily in the US and Europe), there is an ideological polarization of the public on a number of political as well as scientific issues, such as climate change, gun policy, nuclear power, and immigration (Pew Research Center, 2018a,b; Simmons et al., 2018), and it persists despite scientific consensus on many of these contentious issues (Kahan et al., 2011; Lewandowsky et al., 2012). Moreover, research has shown that ideology and partisanship influence information processing and reasoning and judgment of information on some contested issues, e.g., embryonic stem cell research, affirmative action, gun control, capital punishment, climate change (Lord et al., 1979; Nisbet, 2005; Taber and Lodge, 2006; Ho et al., 2008; Hart and Nisbet, 2012; Bolsen and Druckman, 2018).

Since the beginning of the current crisis, political ideology and partisanship have been some of the most salient apparent sources of disagreement on COVID-19 issues. Probably, the most prominent examples of conservative and right-leaning leaders downplaying the severity of the outbreak, attacking experts, and resisting physical distancing are Donald Trump and Jair Bolsonaro. There is some initial evidence of the politicization of the crisis—for example, a Pew poll from March 2020 found that 59% of Democrats vs. 33% of Republicans perceived COVID-19 to be a major threat to the health of the U.S. population (see also Pew Research Center, 2020a,b; Saad, 2020). Being a global crisis and requiring action from political leaders around the world, opinions, policies, and actions regarding COVID-19 may have, indeed, become linked to political identities, thus acting as

an important identity marker or symbol, differentiating right-leaning individuals from the left-leaning ones, at least in some countries. This would be in line with the findings suggesting that individuals are more persuaded by policy experts perceived to hold congenial values and cultural outlooks to their own (Kahan et al., 2010a, 2011).

On the other hand, society generally accepts scientific findings, and, in the absence of cultural or social divisions, citizens generally do form beliefs in accordance with the best available evidence (Kahan et al., 2017). Thus, for example, the public is not polarized about the usefulness of antibiotics in treating bacterial infections, the health risks associated with obesity, etc. The same may be true of attitudes and behaviors regarding the COVID-19 coronavirus pandemic, at least in some countries. Namely, in health crises, people are more likely to trust medical experts than politicians (Albertson and Gadarian, 2015). Also, it is possible that a situation in which individuals feel that they are jointly faced with the same risk may trigger a sense of shared destiny (Van Bavel et al., 2020). The consequent common identity in a global catastrophe situation could, in some way, put ideological differences in the background (Gaertner and Dovidio, 2012; Vezzali et al., 2015; Schellhaas and Dovidio, 2016).

The findings so far regarding the role of political identity in the context of COVID-19 preventive behavior and policy support are mixed. It seems they differ by country (political context) and the stage of the pandemic, whether political identity is operationalized by party affiliation, last voting preference, or political orientation, as well as concrete COVID-19 psychological reaction or behavior.

For example, Harper et al. (2020) conducted a study in the UK at the end of March 2020 and did not find a self-reported measure of political orientation to correlate with behavior change in response to the pandemic (i.e., engaging with WHO-recommended behaviors) or with fear of the novel coronavirus, despite a generally polarized nature of the UK political landscape. Moreover, political orientation did not predict engagement with WHO-recommended behaviors after controlling for fear of the virus (Harper et al., 2020).

However, studies conducted primarily in the US and Canada (regardless of the operationalization of political identity) point to the politicization and public polarization. For example, Pennycook et al. (2021) found that conservatism (a mean of social and economic dimensions), at the end of March 2020, was associated with COVID-19 misperceptions in the US, Canada, and the UK, and the association was greater in the US than in the UK. This pattern was evident for perceptions of COVID-19 risk and behavior change intentions as well. Kerr et al. (2021) investigated the extent of the polarization among the US public across two national studies. The first study conducted in March showed that liberals (compared with conservatives) perceived higher risk, exhibited less trust in politicians to effectively handle the pandemic and more trust of medical experts, such as the WHO, and reported engaging in more health-protective actions. Results of the following study in April 2020 replicated these results when considering partisanship, rather than political ideology.

Overall, increasing evidence suggests that, in the US, Republicans and conservatives tend to express less concern or perceive a lower risk of coronavirus, and are less prone to increased responsible behavior (hygiene and physical distancing) than Democrats and liberals (Allcott et al., 2020; Calvillo et al., 2020; Pickup et al., 2020; Rothgerber et al., 2020; Conway et al., 2021; Kushner Gadarian et al., 2021; Pennycook et al., 2021). In addition, Republicans and conservatives are less accurate at discerning between real and fake news and less likely to share the news with accurate coronavirus content than Democrats or liberals (Calvillo et al., 2020; Pennycook et al., 2020b). In line with this, US studies examining objective indicators, such as GPS location data, Google searches, debit card transactions, provide additional support by showing a higher reduction in mobility in counties and states with lower Republican vote shares (Allcott et al., 2020; Andersen, 2020; Barrios and Hochberg, 2020; Engle et al., 2020; Gollwitzer et al., 2020; Painter and Qiu, 2021).

Identity—Protective Cognition Account of Motivated Reasoning

Following the outlined theoretical review, the question of the role of analytic thinking in motivated reasoning arises. One account that has gained significant traction is the *identity-protective cognition* account (also called “Motivated System 2 Reasoning”), and it postulates that engaging analytic thinking exacerbates motivated reasoning (Kahan, 2013, 2017b). Namely, individuals engage in deliberation and use their cognitive capacities to secure, protect, and defend their (often political) identities and their preexisting beliefs (Kahan et al., 2007; Drummond and Fischhoff, 2017). This can, in turn, lead individuals to become further entrenched in what they already believe, and, consequently, to polarization over contested issues that convey special meaning for opposing groups (i.e., have particular significance for their interests, status, or commitments) to which they belong or have an affinity to (Kahan, 2017a). By this account, individuals equipped with the most proficient Type 2 reasoning capacities end up most polarized. Thus, the identity-protective cognition account is in direct contrast to the classical reasoning account, which presumes that deliberation facilitates accurate belief formation and not ideological or partisan bias.

There is evidence that political polarization about contentious scientific issues and other facts that admit of empirical inquiry is actually greater among individuals who are more reflective (Kahan, 2013), numerical (Kahan et al., 2017), actively open-minded (Kahan and Corbin, 2016; Baron, 2017), and scientifically literate (Hamilton et al., 2012; Kahan et al., 2012; Bolsen et al., 2015; Drummond and Fischhoff, 2017; Motta, 2018; Sarathchandra et al., 2018). On the other hand, some recent findings have supported the classical reasoning account over the identity-protective account by showing that more analytical individuals (indexed by CRT) are less susceptible to false news, whether or not they are consistent with their political ideology (Pennycook and Rand, 2019; Bago et al., 2020).

In the context of the current crisis, a few studies investigated the effect of analytic thinking together with the effect of political ideology on COVID-19 preventive behaviors (Alper et al., 2020; Erceg et al., 2020b; Stanley et al., 2020; Pennycook et al., 2021;

Thoma et al., 2021). Most did not particularly focus on the role of political ideology. Alper et al. (2020), Erceg et al. (2020b), Thoma et al. (2021), and Stanley et al. (2020), measured indicators of analytic thinking (actively opened-minded thinking, faith in intuition, science curiosity, cognitive failures tendency, and CRT) along with a left-right and liberal-conservative political orientation, but only briefly reported on the results (and the latter only in their Supplementary Materials). Thoma et al. (2021) found that political leaning was practically uncorrelated with all of their predictor (except actively open-minded thinking, $r = 0.26$) or outcome (preventive behaviors) measures and did not investigate it any further. Stanley et al. (2020) showed that political and economic conservatism was significantly positively correlated with COVID-19 hoax belief and negatively with distancing behavior but unrelated to handwashing and a number of helping behaviors (also, CRT performance was negatively associated with both political measures). Erceg et al. (2020b) treated political orientation as a control variable and found that right/conservative leaning was predictive of COVID-19 unfounded beliefs, but not of COVID-19 responsible behavior, while Alper et al. (2020) found it was not predictive in either case.

Crucially, only Pennycook et al. (2021) aimed to examine the interactions of these variables in a two-wave study conducted in March and December 2020 in the US, Canada, and the UK. Firstly, they found that polarization was greater in the US than in Canada and the UK, with political conservatism in the US strongly related to weaker mitigation behaviors (regarding hygiene and physical distancing), lower COVID-19 risk perceptions, and greater misperceptions (and stronger vaccination hesitancy, measured only in the second wave). Overall, cognitive sophistication [composite of the CRT performance, numeracy, bullshit receptivity (reverse-scored), and basic science knowledge] was consistently negatively correlated with misperceptions across time, countries, and political lines (whether political ideology as a combined social and fiscal conservatism or partisan identification). On the other hand, cognitive sophistication was not a strong or consistent predictor of COVID-19 risk perceptions or behavior change intentions.

But, moreover, they focused on the interaction of political ideology and cognitive sophistication, which they tested in both waves. In the first wave, they found no evidence for an interaction between ideology and cognitive sophistication in predicting COVID-19 misperceptions, COVID-19 risk perceptions, and behavior change intentions. Thus, contrary to the identity-protective cognition account, the result showed that cognitive sophistication was a better predictor of misperceptions than political ideology in all three countries, with the absence of any interaction. On the other hand, in the US and Canada, only political ideology, i.e., conservatism, significantly predicted weaker engagement in mitigation behaviors.

In the second wave, in the US sample, interestingly, they detected significant interactions of political partisanship and cognitive sophistication for COVID-19 misperceptions, risk perceptions, and behavior change intentions (but not for vaccination intentions). When they zoomed in on the correlation between cognitive sophistication and these measures separately

for strong Democrats and strong Republicans, they found that, although cognitive sophistication was associated with decreased misperceptions for both groups, this association was notably weaker for Republicans compared with Democrats. What is more, risk perceptions and behavior intentions were positively correlated with cognitive sophistication among strong Democrats but nominally negatively (albeit not significantly) correlated with cognitive sophistication among strong Republicans, indicating that polarization seems to widen between partisans with the rise of their reasoning skills. Although this is in line with the identity-protective cognition account, when the authors controlled for liberal and conservative media trust (and their interactions with cognitive sophistication), partisan identification no longer interacted with cognitive sophistication in predicting misperceptions, vaccination intentions, or mitigation behaviors, although it did remain significant for risk perceptions.

Given these initial findings, the question of the role of analytic thinking in motivated reasoning remains open to debate.

The Present Study

We aim to explore the psychological determinants of COVID-19 (self-reported) responsible behavior and policy support, focusing on cognitive and sociopolitical factors, thus seeking to contribute to the emerging discussion with insights within the dual-process framework of human reasoning, and testing the postulates of the identity-protective cognition account and the classical reasoning account.

Specifically, in this study, we examine¹:

(RQ1) whether political orientation predicts adherence to COVID-19 preventive behaviors and policy support and whether this relationship varies across countries.

Since previous results regarding the relationship between political identity and COVID-19 preventive behavior differed for different countries, we expected to detect a degree of variability in this relationship across countries. Based on some initial findings, we tested the hypothesis that COVID-19 has become a politically divisive topic in some countries, which is reflected in relation between political ideology and COVID-19 preventive behaviors and policy support. Moreover, since political ideology can have different meanings in different countries, we expected to be able to differentiate between three groups of countries—countries where a positive correlation between right-leaning orientation and COVID-19 policy support would emerge; countries where this relationship would be in the opposite (negative) direction, and countries where these phenomena would be uncorrelated (suggesting the COVID-19 issue is not politicized).

(RQ2) whether analytic thinking predicts adherence to COVID-19 preventive behaviors and policy support and whether this relationship varies across political contexts.

¹RQ = research questions outlined in our preregistration (Available online at: <https://aspredicted.org/xj83u.pdf>) and further explained here.

Here, we wanted to first test the main effect of analytical thinking on adherence to preventive measures and policy support, the hypothesis being that analytical thinking (cognitive reflection and open-mindedness) should aid deliberation about COVID-19 and lead to scientifically backed reasoning and adherence to preventive measures. Also, we wanted to explore whether this relationship differs across political contexts. Specifically, we wanted to investigate if the effect of analytical thinking on the three outcome measures would be different in countries where a positive correlation between right-leaning orientation and COVID-19 policy support would have emerged vs. countries where this relationship would have been in the opposite (negative) direction, as well as countries where no such relationship existed (indicating that the pandemic has not been politicized).

(RQ3) whether the effect of analytic thinking on adherence to COVID-19 preventive behaviors and policy support is mediated by conspiracy beliefs and whether this relationship varies across political contexts.

Contaminated mindware, i.e., endorsement of COVID-19 conspiracy theories, is hypothesized to mediate the relationship between analytic thinking and adherence to preventive behaviors and policy support. Additionally, this effect could vary across political contexts, being more pronounced in countries where COVID-19 has been politicized—i.e., a group of countries where right-leaning orientation would be associated with COVID-19 policy support and countries where left-leaning orientation would be associated with COVID-19 policy support vs. countries where no such link existed (indicating that the pandemic has not been politicized).

(RQ4) whether political orientation moderates the relationship between analytic thinking and adherence to COVID-19 preventive behaviors and policy support and whether this relationship varies across political contexts.

Put differently, we aimed to investigate whether analytic thinking leads to scientifically recommended preventive behavior overall (in line with the *classical reasoning approach*), or whether it is primarily used to support motivated reasoning, leading to politically polarized behavior (in line with the *identity-protective cognition account*). Here, we first planned to test the potential interaction between analytic thinking and individual-level political orientation. In addition, we wanted to investigate if the possible interaction effects differ on the contextual level—whether the direction of the interaction would be different in countries where a positive correlation between right-leaning orientation and COVID-19 policy support would have emerged vs. countries where this relation would have been in the opposite (negative) direction.

MATERIALS AND METHODS

Participants and Data Collection

Data used in this study were collected within the scope of the “International Collaboration on Social and Moral Psychology

of COVID-19,”² whose initiators launched an open call for international collaborators *via* social media in April 2020. They asked each interested team to collect data from at least 500 participants, representative with respect to age and gender, in their own country. The core team of the project created a survey in English approved by the University of Kent ethics committee.

Data collection was conducted online in 67 countries/regions during April and May 2020, with national teams of each country, including the authors of the present study, translating the questionnaire (a forward–backward method), and administering it to the participants, in most cases with the help of local paneling companies. Such data were gathered to create an overarching database that was used as a source for this study. Overall, the initial sample included 51,717 participants from countries from all the continents (except for Antarctica), with some overrepresented (e.g., from the Americas and Europe) while others underrepresented (e.g., from the Middle East and Africa).

Data cleaning (described in detail in **Supplementary Material**) resulted with a final sample of 12,490 participants from 17 countries with acceptable variability in all of the relevant variables: Australia, Belgium, Canada, Switzerland, Germany, Greece, Iraq, Israel, Japan, South Korea, Nigeria, New Zealand, Pakistan, Poland, Singapore, Slovakia, and the USA. The sex ratio was balanced (51% women), while the average participant was 45.1 years old ($SD = 17.1$).

Measures and Instruments

Outcome Variables

We employed three outcome variables³:

- 1) *avoiding physical contact*, i.e., physical distancing [e.g., during the days of the coronavirus (COVID-19) pandemic, I have been staying at home as much as practically possible]
- 2) *maintaining physical hygiene* [e.g., During the days of the coronavirus (COVID-19) pandemic, I have been washing my hands longer than usual]
- 3) *COVID-19 policy support* [e.g., During the days of the coronavirus (COVID-19) pandemic, I have been in favor of closing all schools and universities].

The first two measures are indicators of adherence to COVID-19 preventive behaviors, while the latter is an indicator of endorsement of COVID-19 preventive measures.

Each construct was operationalized by five items measured on a 0–10 scale with higher values indicating higher levels of the measured construct (with item 2 of the contact subscale being reverse-coded). Due to insufficient variation in multiple countries, item 5 of the contact subscale was excluded from further analyses. The three factors extracted from their respective items exhibited acceptable internal consistency ($\omega_{\text{contact}} = 0.69$, $\omega_{\text{hygiene}} = 0.74$, $\omega_{\text{support}} = 0.86$) and were moderately correlated, implying the existence of a general factor of attitudes and behaviors related to COVID-19 (for further details, see **Supplementary Material**).

²<https://icsmp-covid19.netlify.app/>.

³Items were devised for the purposes of the International Collaboration on the Social and Moral Psychology (ICSMP) of COVID-19 Project.

Indicators of Analytic Thinking

Open-mindedness was operationalized using the open-mindedness subscale from the multidimensional measure of intellectual humility (Alfano et al., 2017). The scale consists of six items, three positively (e.g., If I do not know much about some topic, I don't mind being taught about it, even if I know about other topics.) and three negatively worded (e.g., I think that paying attention to people who disagree with me is a waste of time.). In this study, a unitary latent factor of open-mindedness was extracted with the overall CFA model displaying a very good fit, although the scale exhibited a lower level of reliability ($\omega = 0.53$; for further details, see **Supplementary Material**). Higher scores indicate higher levels of the measured concept.

Our performance-based measure of the disposition and ability to engage in analytic and reflective thinking was the *cognitive reflection test* (Frederick, 2005)—a slightly adapted three-item version, with the structure of the tasks intact, but the numbers and particular subjects, objects, and predicates slightly changed (e.g., A postcard and a pen cost 150 cents in total. The postcard costs 100 cents more than the pen. How many cents does the pen cost?). Due to the low number of included items ($k = 3$), in this study, we were focused only on correct answers (coded as 1), while incorrect and intuitive answers were coded as 0. The sum of scores on these three items represented the total score on cognitive reflection (i.e., the most commonly used scoring technique; but see Erceg and Bubić, 2017 for different scoring procedures).

Hypothesized Moderator and Mediator Variables

A four-item measure of *support for conspiracy theories related to COVID-19* (i.e., COVID-19 conspiracy beliefs) was developed for the purpose of this study. Items presented statements that claimed COVID-19 is a bioweapon or a scam to implement totalitarian regimes, hide the fall of global economy, or allow certain individuals to get economic benefits. The participants rated their agreement with the statements using a 0–10 scale with higher values indicating higher agreement with conspiracy theories. A single factor was extracted from these items, with a very good internal consistency ($\omega = 0.91$; for further details, see **Supplementary Material**).

Political orientation was measured using an 11-point scale, with values lower than the midpoint, indicating political left, and values higher than the midpoint, indicating political right.

Political context represents a complex phenomenon that can be operationalized in multiple ways. In our study, however, the political context simply refers to the overall pattern of the relationship between political ideology and COVID-19 policy support, the logic being that the direction of the relationship should speak to a general left or right political outlook toward restrictive mitigation policies across countries. Thus, we operationalized the COVID-19-related political context *via* correlations between support for COVID-19 policy decisions and political orientation. This context would have reflected whether the COVID-19 pandemic was politicized and the pattern of the polarization on the issue. Specifically, we preregistered that countries where the correlation between political orientation and support for policy decisions would be significantly below -0.10 ,

i.e., where the upper bound of 95% confidence intervals of the correlation between political orientation and support for policy decisions would be below -0.10 , would represent one group. Countries where this correlation would be significantly above 0.10 , i.e., where the lower bound of 95% confidence intervals of the correlation between political orientation and support for restrictive COVID-19 mitigation measures would be above 0.10 , would represent another group. The third in-between group would denote the absence of the aforementioned association. Our preregistered operationalization of political context assumed that this grouping achieved at least partial strong invariance. Unfortunately, as the variation of the relationship between political orientation and policy support was not substantial (see Results section), the grouping of countries based on confidence intervals, as preregistered, would have resulted in the US comprising the first group, with all the remaining countries in the second group. Hence, we decided to follow the basic logic of our preregistered grouping and form the groups based simply on correlations, not confidence intervals, which, of course, presents a deviation from our preregistration.

Analytic Strategy

Our analytic strategy was based on structural equation modeling and accompanying multivariate analyses on a wide cross-cultural data set. We opted for SEM over traditional multivariate techniques because of its advantages, the major ones being: explicit assessment of measurement error, estimation of latent constructs *via* manifest indicators and of the relations among constructs, and providing measures of a global fit of the model to the data. Moreover, the specific reason for using SEM was to be able to first establish invariances (see Vandenberg and Lance, 2000) that allow for the treatment of constructs as identical across different groups and then to examine the relationships between constructs with a verified similar meaning.

We performed all analyses using R version 4.0.3 (R Core Team, 2020), specifically the *semTools* (Jorgensen et al., 2020) and the *lavaan* (Rosseel, 2012) packages for structural equation modeling. The full reproducible code with the results is available in **Supplementary Material**.

Our preregistration can be accessed at <https://aspredicted.org/xj83u.pdf>. All non-preregistered analyses are noted as such.

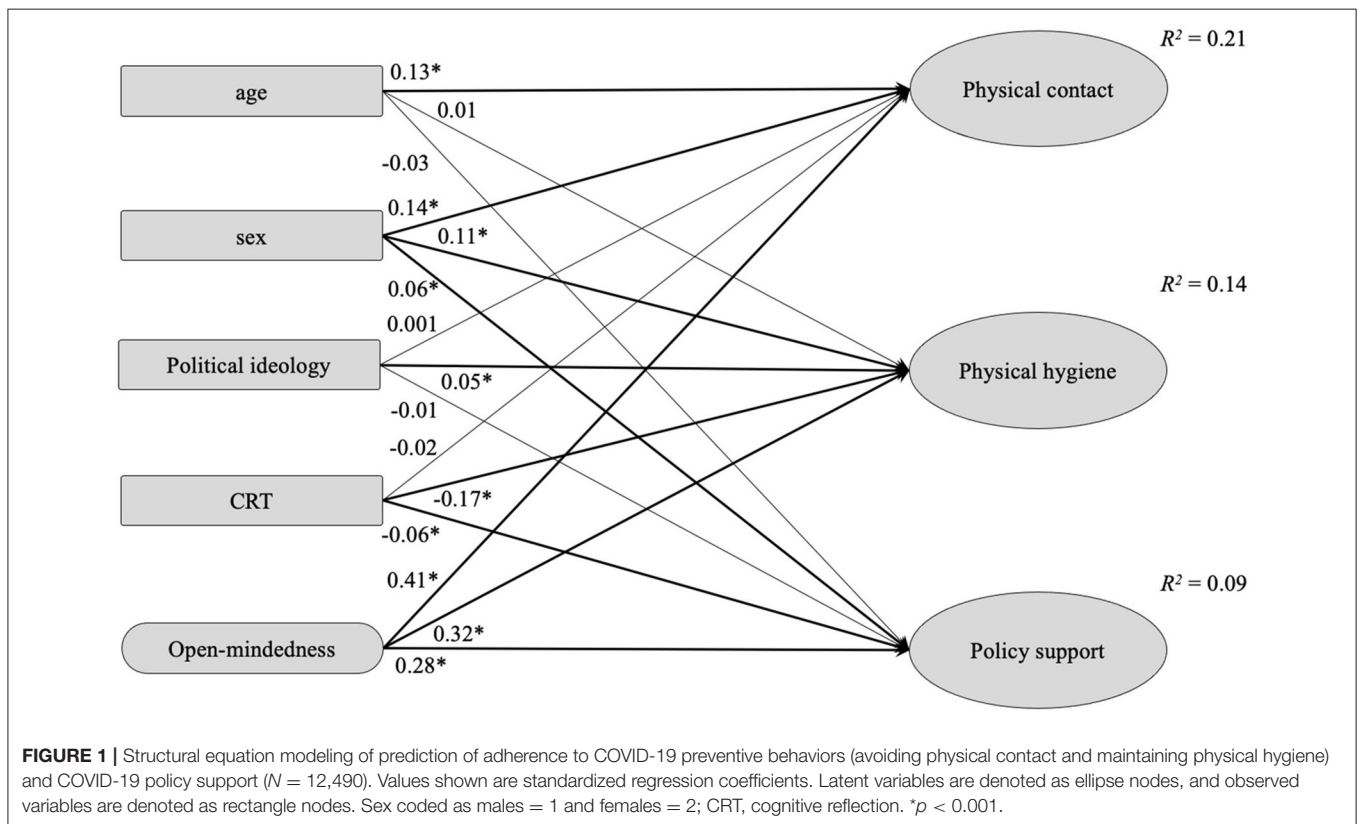
RESULTS

This section summarizes the results of conducted analyses and reflects the order of posed research questions, while the results of confirmatory factor analyses, indicating construct validity of our variables, are presented in **Supplementary Material**, as well as descriptive data and intercorrelations among latent factor scores of outcome variables, open-mindedness and conspiracy beliefs, and manifest variables: simple sum scores of CRT, political ideology and sex and age. Here, we first present the relationships between outcome variables and political orientation, followed by regression, mediation, and moderation analyses. The complete output of all the analyses is available in **Supplementary Material**.

TABLE 1 | Correlations of political orientation with COVID-19 preventive behaviors and policy support across the 17 different countries ($N = 12,490$).

	Political orientation																
	AUS	BEL	CAN	CHE	DEU	GRC	IRQ	ISR	JPN	KOR	NGA	NZL	PAK	POL	SGP	SVK	USA
Physical contact	-0.13	-0.07	-0.1	-0.09	-0.04	0.01	-0.08	-0.02	-0.01	-0.08	0.01	-0.08	-0.03	0.06	0.05	0.03	-0.13
Physical hygiene	-0.02	0	-0.04	-0.04	0.02	0	0	-0.03	0.05	-0.06	0.12	-0.04	0.01	0.06	0.14	0.01	0.05
Policy support	-0.14	-0.12	-0.12	-0.09	-0.05	0.08	-0.07	0.09	0.02	-0.04	0.06	-0.14	-0.08	0.11	0.12	0.06	-0.2

ISO 3166-1 alpha-3 country codes: AUS, Australia; BEL, Belgium; CAN, Canada; CHE, Switzerland; DEU, Germany; GRC, Greece; IRQ, Iraq; ISR, Israel; JPN, Japan; KOR, South Korea; NGA, Nigeria; NZL, New Zealand; PAK, Pakistan; POL, Poland; SGP, Singapore; SVK, Slovakia; USA, United States of America.



Overall, the results presented in **Table 1** suggest the absence of a consistent and practically meaningful relationship between political orientation and COVID-19 preventive behaviors and policy support as they generally shared $<2\%$ of the variance. For all three outcome measures, the correlations in a majority of the countries did not exceed 0.10, and, where they did, they were below 0.20 in magnitude (only in the US for policy support exactly 0.20), i.e., relatively small (Gignac and Szodorai, 2016). This suggests that, although there appeared to be some variation across countries, COVID-19 preventive behaviors and policy support were largely unpoliticized at the time when the survey was conducted. The strongest association with political ideology was observed in the case of the USA: -0.2 for policy support and -0.13 physical distancing, then -0.14 in both Austria and New Zealand for policy support, and in the case of Singapore: 0.14 for physical hygiene and 0.12 for policy support.

Secondly, we tested whether analytic thinking predicted COVID-19 responses (**Figure 1**). The model achieved an adequate data fit (robust CFI = 0.944, robust RMSEA = 0.048, SRMR = 0.044). After controlling for age and sex, open-mindedness emerged as a positive predictor of avoiding physical contact, stricter physical hygiene, and policy support related to the COVID-19 pandemic. Higher CRT scores predicted slightly decreased physical hygiene and policy support. As expected from the zero-order correlations, political ideology did not exhibit a relevant predictive effect.

Furthermore, we tested if these relationships varied across political contexts. Following the principal logic of our preregistered operationalization of political context based simply on correlations between political orientation and policy support but diverging from our preregistration as we did not take into account the confidence intervals, we grouped

Australia, Belgium, Canada, New Zealand, and the US together as countries where right-leaning orientation was correlated ($r \geq 0.10$) with COVID-19 policy support. Poland and Singapore formed a group of countries where left-leaning orientation was correlated ($r \leq -0.10$) with COVID-19 policy support, with the remaining countries forming a “neutral” group where no such link ($-0.10 < r < 0.10$) was detected, thus indicating that the pandemic has not been politicized. Based on the notion that mediation cannot vary if regression slopes forming it do not vary, we tested the variations in regression

slopes of the new models and found no significant differences (Table 2).

In the next step, we tested if COVID-19 conspiracy beliefs mediated the relationship between analytic thinking and COVID-preventive behaviors and policy support (Figure 2). The model achieved an adequate fit (robust CFI = 0.943, robust RMSEA = 0.048, SRMR = 0.060) and demonstrated that support for conspiracy theories was negative, albeit a relatively weak predictor of physical contact and policy support. It mediated only a minor portion of the relationships between open-mindedness (indirect $\beta = 0.03$, $p < 0.001$ for physical contact, indirect $\beta = 0.03$, $p < 0.001$ for policy support, and indirect $\beta = 0.01$, $p = 0.112$ for physical hygiene) and CRT (indirect $\beta = 0.04$, $p < 0.001$ for physical contact, indirect $\beta = 0.04$, $p < 0.001$ for policy support and indirect $\beta = 0.01$, $p = 0.114$ for physical hygiene) with COVID-19 behaviors and attitudes, with the effects being significant mainly due to sample size. Only 9.4% of the variance of COVID-19-related conspiracy beliefs was explained in this model.

In the following step, we tested if the detected mediation varied across political contexts defined by our country grouping

TABLE 2 | Invariance of analytic thinking in prediction of COVID-19 preventive behaviors and policy support across the three political contexts ($N = 12,490$).

Level of invariance	Robust CFI	Robust RMSEA	SRMR
Configural	0.934	0.052	0.05
Metric	0.932	0.052	0.052
Scalar	0.921	0.055	0.054
Regressions	0.919	0.055	0.056

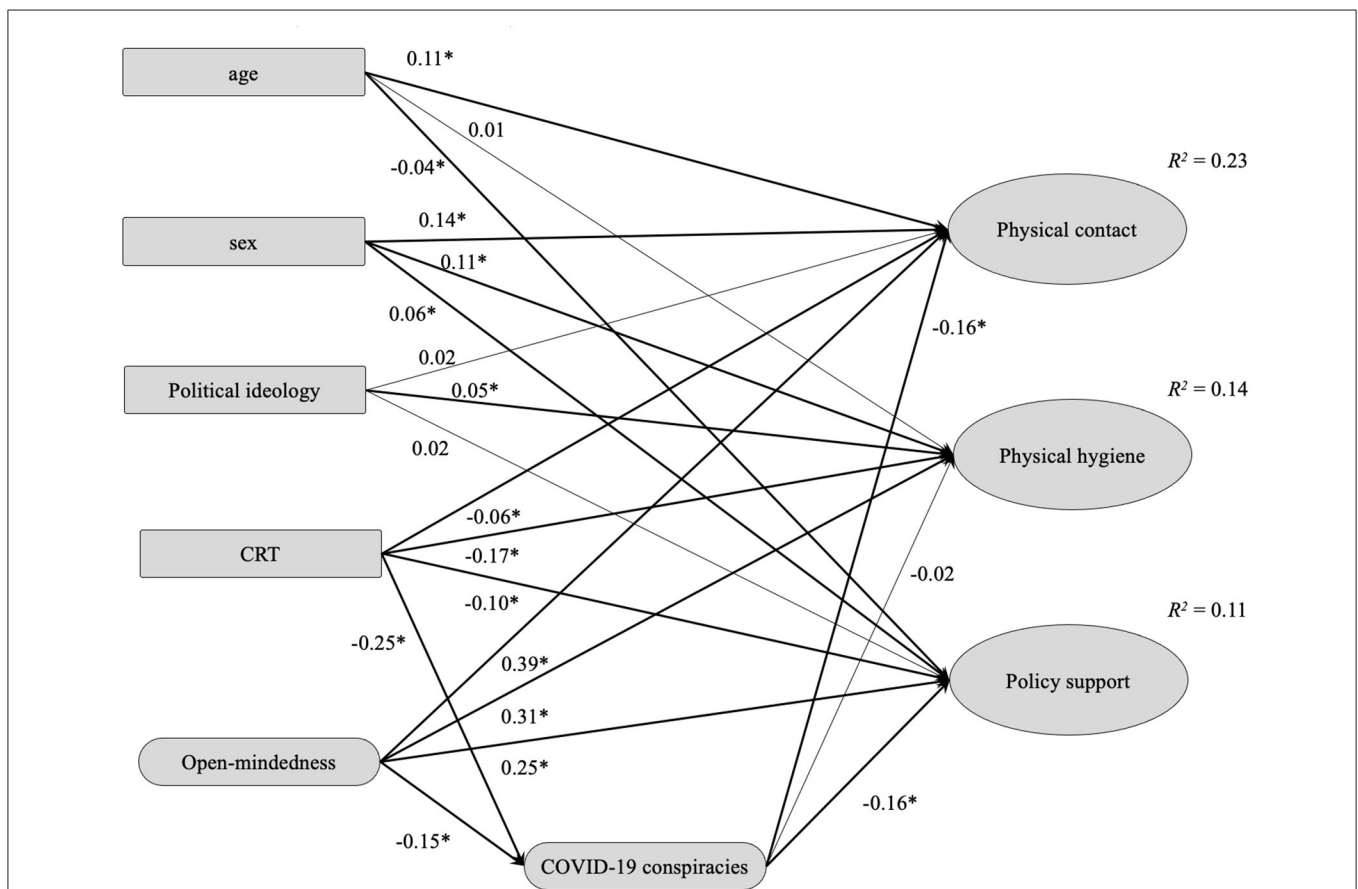


FIGURE 2 | Structural equation modeling of belief in COVID-19 conspiracies as a mediator of the relationship of open-mindedness and CRT with COVID-19 preventive behaviors and policy support ($N = 12,490$). Values shown are standardized regression coefficients. Latent variables are denoted as ellipse nodes, and observed variables are denoted as rectangle nodes. Sex coded as males = 1 and females = 2; CRT, cognitive reflection. * $p < 0.001$.

(based on correlations between political orientation and policy support as before) by employing invariance testing which (as in the former case) indicated that no significant variation across the context existed (Table 3).

Finally, we tested if political orientation moderated the relationship between analytic thinking and COVID-19 preventive behaviors and policy support. To compute these analyses, we extracted the factor scores from the model that

achieved strong invariance before including conspiracy beliefs (Figure 1), using the Ten Berge method (see Ten Berge, 1977), and multiplied their scaled version with a scaled version of political orientation.

As evident from Table 4, the interactions of political ideology with CRT and open-mindedness in the prediction of our three dependent variables were all practically negligible.

Additionally, results of invariance testing did not indicate significant differences in these relationships across political contexts defined by our country grouping based on correlations between political orientation and policy support (Table 5).

Although the interactions of political ideology and the two indicators of analytic thinking were negligible and did not vary across political contexts, i.e., the three country groups, for exploratory purposes of comparing our results with the results of Pennycook et al. (2021), we decided to focus on these relationships in the US and Canadian sample.

Hence, we conducted path analyses. Separate models were formed to test the contribution of each interaction (open-mindedness and the three outcome variables and CRT and

TABLE 3 | Invariance of belief in COVID-19 conspiracies as a mediator in the prediction of COVID-19 preventive behaviors and policy support on analytic thinking across the three political contexts ($N = 12,490$).

Level of invariance	Robust CFI	Robust RMSEA	SRMR
Configural	0.93	0.054	0.068
Metric	0.928	0.053	0.069
Scalar	0.919	0.056	0.07
Regressions	0.918	0.055	0.073

TABLE 4 | Multiple regression analyses interacting political orientation with open-mindedness and cognitive reflection in the prediction of our three dependent variables ($N = 12,490$).

	b (SE)	β	b (SE)	β
Physical contact				
Age	0.004 (< 0.001) ***	0.07 ***	0.004 (< 0.001) ***	0.07 ***
Sex ^a	0.21 (0.02) ***	0.1 ***	0.21 (0.02) ***	0.1 ***
Political orientation	-0.002 (0.004)	-0.003	-0.003 (0.004)	-0.01
Open-mindedness	0.43 (0.01) ***	0.43 ***	0.43 (0.01) ***	0.43 ***
CRT	-0.04 (0.01) ***	-0.04 ***	-0.04 (0.01) ***	-0.04 ***
Open-mindedness × Political orientation	-0.02 (0.01) *	-0.02 *		
CRT × Political orientation			-0.02 (0.01) *	-0.02 *
R^2	0.21		0.21	
Physical hygiene				
Age	-0.001 (< 0.001)	-0.01	-0.001 (< 0.001)	-0.01
Sex ^a	0.19 (0.02) ***	0.1 ***	0.19 (0.02) ***	0.1 ***
Political orientation	0.02 (0.004) ***	0.04 ***	0.02 (0.004) ***	0.04 ***
Open-mindedness	0.32 (0.01) ***	0.32 ***	0.32 (0.01) ***	0.32 ***
CRT	-0.14 (0.01) ***	-0.15 ***	-0.15 (0.01) ***	-0.16 ***
Open-mindedness × Political orientation	-0.02 (0.01) *	-0.02 *		
CRT × Political orientation			-0.03 (0.01) **	-0.03 **
R^2	0.14		0.14	
Policy support				
Age	-0.003 (< 0.001) ***	-0.05 ***	-0.003 (< 0.001) ***	-0.05 ***
Sex ^a	0.08 (0.02) ***	0.04 ***	0.08 (0.02) ***	0.04 ***
Political orientation	-0.004 (0.004)	-0.01	-0.01 (0.004)	-0.01
Open-mindedness	0.28 (0.01) ***	0.28 ***	0.28 (0.01) ***	0.28 ***
CRT	-0.07 (0.01) ***	-0.08 ***	-0.07 (0.01) ***	-0.08 ***
Open-mindedness × Political orientation	-0.02 (0.01) *	-0.02 *		
CRT × Political orientation			-0.02 (0.01) *	-0.02 *
R^2	0.09		0.09	

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

^aSex coded as males = 1 and females = 2.

the three outcome variables) in the US and Canadian samples (Table 6). None of the interactions emerged as significant, following the preset criteria of $p < 0.001$. Yet it is reasonable to

assume that interaction effects are smaller, and detecting them requires more power (McClelland and Judd, 1993; see Gelman, 2018). Thus, we report and explore the effects at less stringent significance thresholds.

Overall, all the models showed weak, both main and interaction, effects with the exception of the main effect of open-mindedness, which was expected based on our previous overall results. But the goal was to focus on the interactions, and some interesting trends emerged.

In the case of Canada, a weak interaction between CRT and ideology was observed in predicting reduced physical contact and stricter physical hygiene. To clarify these interactions, we plotted them.

Figure 3 shows that a weak negative effect of CRT on hygiene maintenance was driven primarily by right leaning reflective individuals who were more likely not to adhere to stricter hygiene practices. This was even more evident regarding physical distancing. As can be observed in Figure 4, the most reflective individuals were the ones differing the most in their tendency

TABLE 5 | Invariance of political orientation as a moderator of the relationship between analytic thinking and COVID-19 preventive behaviors and policy support across the three political contexts ($N = 12,490$).

IVs	Constraints	Robust CFI	Robust RMSEA	SRMR
CRT	Scalar invariance	0.998	0.034	0.005
	Scalar invariance + constrained interactions	0.997	0.027	0.006
Open-mindedness	Scalar invariance	0.998	0.035	0.005
	Scalar invariance + constrained interactions	0.998	0.027	0.006

TABLE 6 | Multiple regression analyses interacting political orientation with open-mindedness and cognitive reflection in the prediction of our three dependent variables on separate samples from Canada ($n = 740$) and the USA ($n = 905$).

	Canada ($n = 740$)				US ($n = 905$)			
	<i>b</i> (SE)	β	<i>b</i> (SE)	β	<i>b</i> (SE)	β	<i>b</i> (SE)	β
Physical contact								
Age	0.01 (0.002)***	0.12***	0.01 (0.002)***	0.11***	0.01 (0.002)**	0.09**	0.01 (0.002)**	0.09**
Sex ^a	0.19 (0.06)**	0.09**	0.19 (0.06)**	0.09**	0.15 (0.05)**	0.07**	0.14 (0.05)**	0.07**
Political orientation	-0.05 (0.02)*	-0.09*	-0.05 (0.02)*	-0.09*	-0.02 (0.01)	-0.04	-0.03 (0.01)*	-0.07*
Open-mindedness	0.36 (0.04)***	0.36***	0.36 (0.04)***	0.36***	0.52 (0.04)***	0.52***	0.52 (0.03)***	0.52***
CRT	-0.04 (0.03)	-0.04	-0.07 (0.04)	-0.08	-0.06 (0.03)	-0.05	-0.07 (0.03)*	-0.06*
Open-mindedness × political orientation	-0.02 (0.05)	-0.01			-0.02 (0.03)	-0.02		
CRT × political orientation			-0.12 (0.05)**	-0.1**			-0.06 (0.03)*	-0.07*
R^2	0.16		0.17		0.31		0.32	
Physical hygiene								
Age	-0.001 (0.002)	-0.02	-0.001 (0.002)	-0.02	-0.001 (0.002)	-0.01	-0.001 (0.002)	-0.02
Sex ^a	0.24 (0.06)***	0.12***	0.24 (0.06)***	0.12***	0.16 (0.06)**	0.08**	0.15 (0.06)**	0.08**
Political orientation	-0.002 (0.02)	-0.003	-0.002 (0.02)	-0.004	0.03 (0.01)**	0.09**	0.03 (0.02)*	0.08*
Open-mindedness	0.34 (0.04)***	0.34***	0.34 (0.04)***	0.34***	0.39 (0.04)***	0.4***	0.39 (0.04)***	0.39***
CRT	-0.11 (0.03)**	-0.11**	-0.13 (0.04)**	-0.13**	-0.21 (0.04)***	-0.19***	-0.21 (0.04)***	-0.19***
Open-mindedness × political orientation	-0.04 (0.04)	-0.03			-0.01 (0.03)	-0.01		
CRT × political orientation			-0.1 (0.05)*	-0.08*			-0.002 (0.04)	-0.002
R^2	0.15		0.16		0.2		0.2	
Policy support								
Age	0.01 (0.002)**	0.09**	0.01 (0.002)**	0.08**	0.003 (0.002)	0.06	0.004 (0.002)*	0.06*
Sex ^a	0.06 (0.06)	0.03	0.06 (0.06)	0.03	0.07 (0.06)	0.03	0.07 (0.06)	0.03
Political orientation	-0.07 (0.02)***	-0.13***	-0.08 (0.02)***	-0.14***	-0.05 (0.01)***	-0.13***	-0.06 (0.01)***	-0.17***
Open-mindedness	0.24 (0.04)***	0.24***	0.25 (0.04)***	0.25***	0.38 (0.03)***	0.38***	0.38 (0.03)***	0.38***
CRT	-0.04 (0.03)	-0.04	-0.06 (0.04)	-0.06	-0.06 (0.04)	-0.05	-0.06 (0.04)	-0.06
Open-mindedness × political orientation	-0.06 (0.05)	-0.05			-0.01 (0.02)	-0.01		
CRT × political orientation			-0.07 (0.04)	-0.06			-0.09 (0.03)**	-0.1**
R^2	0.09		0.09		0.19		0.19	

*** $p < 0.001$, ** $p \leq 0.01$, * $p < 0.05$.

^aSex coded as males = 1 and females = 2.

to physical distancing, depending on their political outlook. It seems that, although cognitive reflection does not lead left-leaning individuals to engage in more distancing behavior, with an increase in cognitive reflection, the right-leaning ones are less prone to engage in physical distancing, and the same pattern is visible in the US sample when it comes to predicting physical distancing (Figure 5), as well as policy support (Figure 6).

This broadly supplies some evidence consistent with the identity-protective cognition account but, of course, has to be treated/interpreted with caution since our analysis was exploratory and deviated from our preregistration. In addition, we did not measure any other potentially relevant variables, such as liberal and conservative media trust for which Pennycook et al. (2021) showed that, when controlled for, leads to political identity no longer interacting with cognitive sophistication.

Finally, models with moderation were also tested for variation across the two countries, and no indications in favor of such variation were found (Table 7).

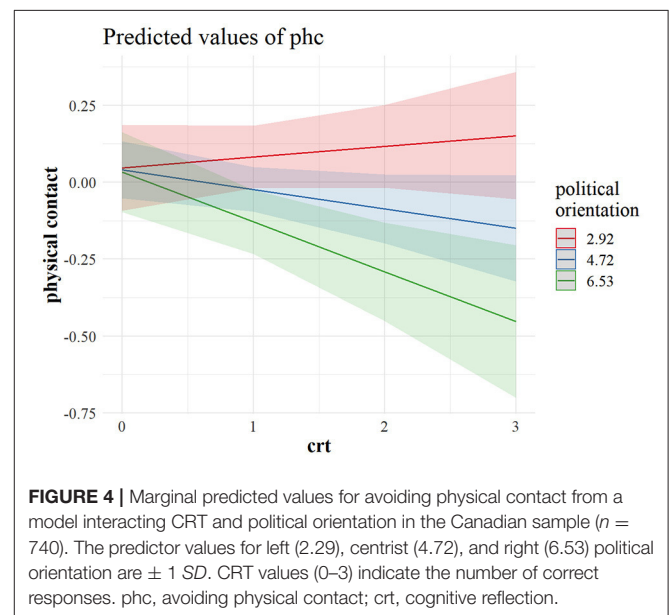
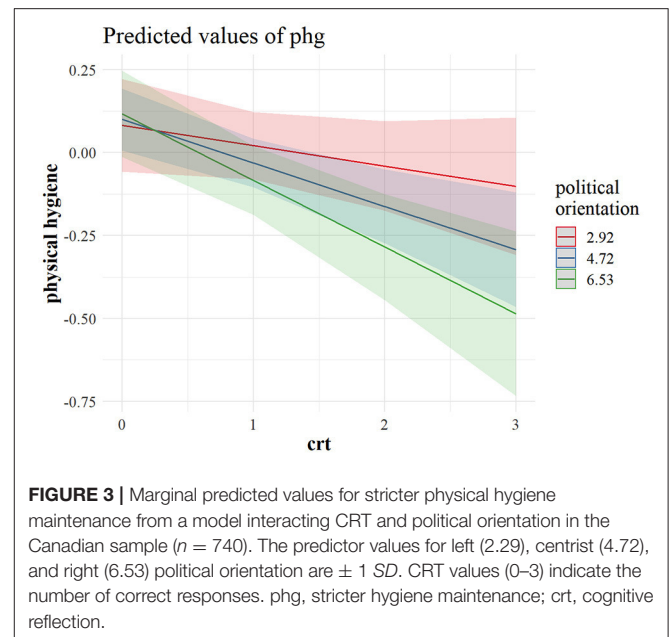
DISCUSSION

Dealing with this global health crisis exhorts large-scale behavior change, the so-called new normal, and poses a considerable psychological load on individuals. Therefore, we tried to contribute to a collaborative effort in social and behavioral sciences in providing valuable insights from within the dual-process framework regarding the determinants of COVID-19 preventive behavior and policy support. In particular, we focused on the role of analytic propensity and political ideology, factors that have been shown to affect reasoning and decisions-making regarding many contested issues. We wanted to investigate how it may translate to the issue of preventive behavior and policy support in the context of the COVID-19 pandemic.

Regarding the question of the relationship between political orientation and COVID-19 preventive behaviors and policy support, i.e., whether it varies across countries (RQ1), political orientation, generally, was not substantially related to COVID-19 self-reported behaviors and opinions, with it generally explaining <2% of their variance across different countries. This result was in line with the other studies conducted in March and April 2020 (Alper et al., 2020; Erceg et al., 2020b; Thoma et al., 2021), showing no or relatively weak associations of political ideology and COVID-19 preventive behaviors.

On the other hand, based on some evidence outlined in the introduction, which suggested the possibility of politicization and, consequently, polarization of COVID-19 issues, we expected to find some degree of variability in the relationship between political ideology and COVID-19 policy support and, possibly, preventive behaviors across countries. Indeed, in line with previous research, the strongest correlations were observed in the case of the USA for physical distancing and policy support (see also Choma et al., 2021).

If, in fact, a strong link between these phenomena exists, at least in some countries, several reasons may explain our results. Firstly, there is an obvious weakness of the used measure of political orientation—a single item likely connoting different



meanings across the 17 different countries. We did not have any other individual-level measure of political ideology, such as party affiliation at our disposal. Namely, in the US, party identification or leaning is commonly used, often yielding stronger polarization effects (e.g., Kahan et al., 2012; McPhetres et al., 2021), this being the case in the pandemic context as well (Pennycook et al., 2021). Also, ideology and partisanship are not the only basis on which the public is divided on many issues regarding decision-relevant science. Other ideological factors, such as “cultural worldviews” proposed by Kahan (e.g., Kahan et al., 2010b, 2012) could also be implicated in motivated reasoning.

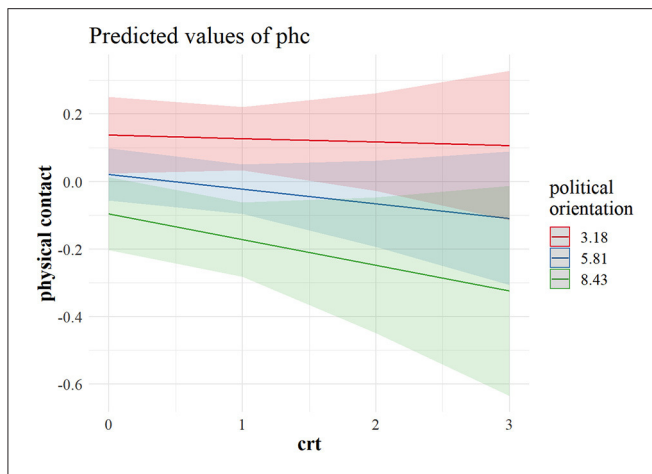


FIGURE 5 | Marginal predicted values for avoiding physical contact from a model interacting CRT and political orientation in the US sample ($n = 905$). The predictor values for left (3.18), centrist (5.81), and right (8.43) political orientation are ± 1 SD. CRT values (0–3) indicate the number of correct responses. phc, avoiding physical contact; crt, cognitive reflection.

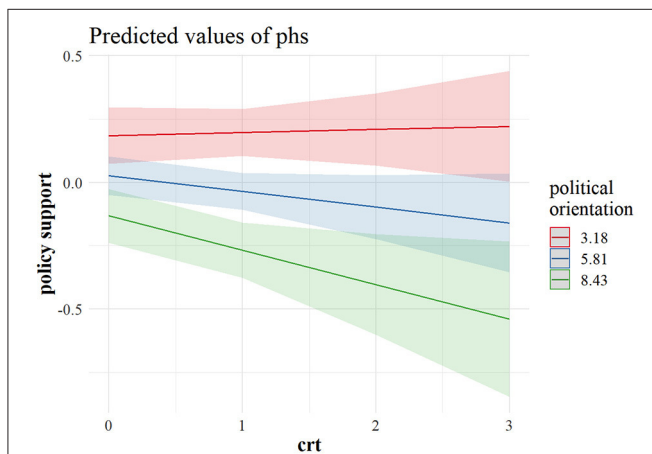


FIGURE 6 | Marginal predicted values for policy support from a model interacting CRT and political orientation in the US sample ($n = 905$). The predictor values for left (3.18), centrist (5.81), and right (8.43) political orientation are ± 1 SD. CRT values (0–3) indicate the number of correct responses. phs, support for restrictive COVID-19 policies; crt, cognitive reflection.

Furthermore, there is evidence that, in March 2020, there were partisan differences, both in the US and Canada, regarding COVID-19 concern, government reaction assessments, confidence in government ability to deal with the pandemic, and self-reported behavior change (e.g., Pickup et al., 2020; Pennycook et al., 2021), but the same pattern was not evident in the UK (Pennycook et al., 2021). Moreover, these differences might have widened as the pandemic progressed. Pennycook et al. (2021) found that political polarization seemed to have increased between their first study conducted in March and the second one in December, indicated by a noticeable increase in the correlation between political ideology and risk perceptions ($r_1 =$

TABLE 7 | Invariance of interactions of political orientation with CRT and open-mindedness across the two countries: Canada and the USA.

IVs	Constraints	Robust CFI	Robust RMSEA	SRMR
CRT	Scalar invariance	0.999	0.029	0.005
	Scalar invariance + constrained interactions	0.998	0.027	0.007
Open-mindedness	Scalar invariance	0.999	0.024	0.005
	Scalar invariance + constrained interactions	1	0	0.006

-0.36 in Study 1, $r_2 = -0.54$ in Study 2) and misperceptions ($r_1 = 0.31$, $r_2 = 0.51$), as well as mitigation behavior ($r_1 = -0.15$, $r_2 = -0.36$) in the US, but this noticeable increase was not apparent or less so (mitigation behavior: $r_1 = 0.07$, $r_2 = -0.02$; risk perceptions: $r_1 = -0.02$, $r_2 = -0.18$; misperceptions: $r_1 = 0.14$, $r_2 = 0.21$) in the UK (unfortunately, they did not include a Canadian sample in their second study). Thus, the point of time in the progression of the pandemic might matter and for a clearer and more nuanced look at this question, the need for longitudinal studies is evident and essential.

Taking this together, there is evidence for the current crisis evoking both ideological differences in motivated reasoning in some countries, or conversely a sense of shared humanity and destiny, putting the common ideological differences aside in others (Gaertner and Dovidio, 2012; Vezzali et al., 2015; Schellhaas and Dovidio, 2016; Van Bavel et al., 2020). Still, in view of the dynamic aspect of the many cognitive processes operating in the background, this question begets further investigation, especially in light of observed deepening political debates about crisis management and mitigation behaviors, following our research.

Regarding the role of analytic thinking, political orientation and conspiracy beliefs in predicting the adherence to preventive behaviors and policy support (RQ2, RQ3), the SEM models we tested (both simple and mediation models), show that endorsement of and adherence to COVID-19 preventive measures follow primarily (considering investigated variables), from an open-minded outlook, over and above political ideology and cognitive reflection. While open-mindedness was a considerable predictor of inclination to all three outcome measures, CRT was predictive of lower adherence to stricter hygiene maintenance and lower support of restrictive COVID-19 policies, albeit these effects were weak and possibly significant due to the sample size. Political ideology, practically, did not exhibit any effects (as expected due to its generally low correlations observed across countries), although a very weak positive relationship of a right-leaning outlook and stricter hygiene managed to reach the threshold for statistical significance, again mainly due to the sample size. In addition, there was a partial mediation effect of COVID-19 conspiracy beliefs on the relationship of open-mindedness and CRT with two out of the three dependent variables, which indicates that

less open-minded and more reflective individuals engaged in less physical distancing and were less supportive of restrictive policies partly due to their support for COVID-19 conspiracy theories as well (although noting again that these effects are small in size). All of these predictive effects stood controlling for sex and age.

In sum, as expected, we found that the indicators of analytic thinking, especially the propensity for open-minded thinking, were relevant determinates of preventive behavior and policy support. In fact, they were stronger predictors than political ideology. Overall, the two indicators of analytic thinking, together with political ideology, sex, and age explained between 9 and 21% of the variance of the three dependent variables (whereas the mediation model which included COVID-19 conspiracy beliefs explained 11–23% of the outcome variables). This might not appear to be a sizable amount, but considering only two short cognitive measures (especially the three-item CRT) were used, and, for example, compared with the theory of planned behavior, a prominent social cognition theory, which has been shown to account for around 14–40% of the variance in behavior and behavior intentions (Armitage and Conner, 2001; McEachan et al., 2011), it presents a relevant result and a notable avenue worth pursuing in further research.

Moreover, from the dual-process perspective, our results resonate with the notion that the ability and disposition to engage analytic thinking is not the same as having a general open-minded stance (Baron, 1985; Stanovich and West, 1997), suggesting that, for COVID-19 mitigation behavior, the latter seems more important. As expected, individuals more open to new information and knowledge, unconstrained by prior or favored beliefs, were more likely to engage in and support preventive measures. This finding is convergent with recent evidence, suggesting that actively open-minded thinking (about evidence) is robustly associated with acceptance of science and (negatively) with a range of unfounded beliefs (e.g., paranormal and conspiracy beliefs) and more strongly and over and above cognitive reflection (Pennycook et al., 2020a).

What was not expected is for cognitively reflective individuals to be somewhat less likely to adhere to stricter hygiene maintenance and support restrictive policies. However, CRT did correlate positively, albeit weakly, with open-mindedness (0.09, $p < 0.001$), meaning that the two indicators of analytic thinking were related (albeit weakly) in the direction expected within the dual-process framework (e.g., Stanovich et al., 2016; also Baron et al., 2015).

The results regarding the CRT are comparable to the findings of Thoma et al. (2021). Interestingly, they also found that cognitively reflective individuals adopted fewer preventive behaviors (open-mindedness in their case was not predictive at all). What is more, they found that the only factor of the underlying individual responses referring to COVID-19 prevention measures that were positively correlated with CRT was cleanliness (wash, soap, face, disinfect), conspicuously similar to our physical hygiene maintenance measure, which, in our case, also exhibited the strongest relationship with CRT. Guided by classical reasoning account within the dual-process framework, both Thoma et al. (2021) and we expected the

reflective individuals, ones more able to detect and overcome their automatic, intuitive responses (previous behavior), to be more likely to engage in the recommended distancing and hygiene behaviors deemed relevant for controlling and mitigating the spread of COVID-19. Namely, these demanding behavior changes should be easier for them to appreciate as rational in the current situation, as well as adhere to. Indeed, there is some evidence that cognitive intuition (calculated as a mean of intuitive responses on the CRT, as opposed to cognitive reflection) predicts lesser adherence to COVID-19 guidelines (Teovanović et al., 2021).

So, what could account for our results? There are several potential reasons some of them also considered by Thoma et al. (2021). Firstly, as Thoma et al. (2021) also noted, previous research showed CRT to be related to numeracy (e.g., Cokely and Kelley, 2009; Campitelli and Gerrans, 2014; Thomson and Oppenheimer, 2016; Szaszi et al., 2017), which is generally higher among men. Although this may explain the correlation of CRT (especially the classical three items) and gender (Baron et al., 2015), we have controlled for the effects of sex in our SEM models. In addition, we observed a negative correlation of sex and CRT, with females likely to score lower ($r = -0.17$, $p < 0.001$), while higher open-mindedness was weakly associated with females ($r = 0.08$, $p < 0.001$, see data output in **Supplementary Material**).

Furthermore, Baron argued (Baron et al., 2015; Baron, 2017, 2019) that CRT is, primarily, a measure of a reflection/impulsivity trait, i.e., the amount (but see Raoelison et al., 2020 for a “logical intuitions” perspective) opposed to the direction (fairness of the direction to both sides vs. my side bias) of thinking, which is better tapped by open-minded thinking. The two are related because being actively open to new information and knowledge will result in increased search, he suggested (Baron, 2019). Additionally, Baron (2019) and Thoma et al. (2021), referring to arguments made by other researchers, pointed that, in well-structured laboratory settings where normative responses are clearly defined, more search leads to better normative judgment, while this might not be the case in real-world situations. When it comes to important and controversial questions, we might engage reflective capacities in motivated reasoning (e.g., Kahan, 2013, 2017a,b; Baron, 2017), or as Stanovich (2004, pp. 228–243) proposes successful Type-2 override outcomes may be rejected to achieve rational integration of preferences, or as Risen (2016) suggests “acquiescence” is a possible Type 2 response (detecting an error, but choosing not to correct it).

Another possibility is that, during the first wave of the pandemic, at a time when almost all countries had some kind of restrictive policies in place (Hale et al., 2021), cognitively reflective individuals were reflecting on various, sometimes even miscommunicated or seemingly contradictory, guidelines and measures, dissected them and their consequences rather than simply complying. In such uncertain circumstances, with generally high levels of compliance observed around the world, what was cognitively or behaviorally more effortful and rational or irrational may be open to some debate.

And, finally, also mentioned by Thoma et al. (2021), a negative relationship of CRT and cooperation and prosociality (e.g., Rand

et al., 2012; Capraro et al., 2017) may contribute to the negative predictive effect of CRT. Namely, theoretical and empirical work suggests that, in social environments where cooperation, on average, leads to better individual outcomes, intuition leads to prosociality (Rand et al., 2014; Rand, 2016; Everett et al., 2017; but see Chen et al., 2013; Verkoeijen and Bouwmeester, 2014). Unfortunately, the design of our research did not permit us to test these different possibilities. Thus, these speculative arguments are in need of clear empirical testing. However, our last question (RQ4) is aimed at exploring the possibility that cognitive reflection and open-mindedness may be utilized in motivated reasoning, which we intended to investigate by interacting political orientation with CRT and open-mindedness in predicting preventive behaviors and policy support (discussed further down).

The partial mediation effects we found are in line with theoretical expectations and consistent with a growing body of evidence, suggesting a general detrimental effect of inclination toward conspiracist thinking on reasoning and decision-making, but, moreover, with evidence, thus far, on the role of different COVID-19 unfounded beliefs, most prominently conspiracy beliefs in the current crisis (Erceg et al., 2020b; Imhoff and Lamberty, 2020; Pennycook et al., 2020b; Stanley et al., 2020; Swami and Barron, 2020; Pavela Banai et al., 2021). In fact, our results (albeit weak in size) are generally consistent with other studies that specifically tested and provided evidence for mediating effects of various misperceptions and unfounded beliefs and knowledge about COVID-19 on the relationship between indicators of analytic thinking and preventive behavior (Erceg et al., 2020b; Stanley et al., 2020; Swami and Barron, 2020). Taken together, these results broadly speak to the importance of having the right, uncontaminated mindware—in addition to having an efficient analytic processor and a tendency to engage it; unhindered rational reasoning and judgment requires mindware that is not contaminated with epistemically suspect beliefs and attitudes not founded in evidence (Stanovich et al., 2016; Rizeq et al., 2021).

Our next question (RQ4) on whether political orientation moderates the relationship between analytic thinking and COVID-19 preventive behaviors and policy support required analyzing the interaction of individual-level political orientation and analytic thinking in the prediction of the three outcome variables. On an overall sample, the interaction effects were negligible.

We also wanted to investigate whether the relationships between political orientation, analytic thinking, and COVID-19 conspiracy beliefs vary across political contexts defined *via* the direction of the relationship of political orientation and policy support. We found no evidence that the SEM model, including only direct effects of political orientation and analytic thinking, neither the SEM model with the mediation effects of conspiracy beliefs included, nor the modeled interactions of political orientation with the two indicators of analytic thinking varied across the three country groups (Tables 2, 3, 5). Put differently, we did not observe the effect of analytical thinking on the three outcome measures being different in countries where a relatively positive correlation between right-leaning

orientation and COVID-19 policy emerged vs. countries where this relationship was in the opposite (negative) direction, or countries where no such relationship existed (indicating that the pandemic has not been politicized). This was an expected result of political orientation, generally weakly correlating with policy support (admittedly, a somewhat circular operationalization of political context *via* the association of individual-level variables).

Finally, our last exploratory analyses were not preregistered as we wanted to seize the opportunity and directly compare our results in the two countries included in the research of ours and Pennycook et al. (2021) and gain some insight into whether analytic thinking leads to universally advocated preventive behaviors and policy support, or whether it is primarily co-opted to support motivated reasoning, thus leading to increased political polarization. Although on the level of the entire sample, the moderating effects of political orientation proved to be negligible (and did not vary across political contexts), we focused on running the analyses on the Canadian and US samples separately. The results point to a possibility of interactions between CRT and political ideology in predicting reduced physical contact and stricter physical hygiene. The findings, which we interpret only as indicative trends, show that, in the case of Canada, a weak negative effect of CRT was driven primarily by right-leaning reflective individuals who were more likely *not to adhere* to physical distancing and stricter hygiene practice, with the same pattern being visible in the US sample when it comes to predicting physical distancing and policy support. In fact, the moderations models did not seem to vary across the two countries as indicated by our results of invariance testing. The overall pattern was that the most reflective individuals seemed to be the ones differing the most in their tendency to adhere to preventive behaviors and support restrictive policies conditional on their political outlook. Specifically, a trend we observed was: although cognitive reflection may not lead left-leaning individuals to engage in more preventive behavior and exhibit stronger policy support, with an increase in cognitive reflection, the right-leaning ones seem less prone to engage in physical distancing in both countries, and in the US they seem less likely to support restrictive policies, while in Canada less likely to adhere to stricter hygiene. This would broadly be in line with the identity-protective cognition account, even in the early stages of the pandemic. As we have already stressed, in addition to not being preregistered, our analysis yielded minor interaction effects. We have to note that, unlike Pennycook et al. (2021), we did not have data on partisan identification, which may be deemed a stronger measure of political identity, especially in the US. In addition, Pennycook et al. (2021) also used a composite measure of cognitive sophistication (science knowledge, CRT, numeracy, and bushtit receptivity). Also, we were unable to control for other potentially relevant variables which could attenuate or diminish these effects, such as liberal and conservative media trust which Pennycook et al. (2021) controlled for. By presenting these results, our desire is to encourage further research, providing more evidence for the debate of the two accounts of the role of analytic thinking in motivated reasoning and behavior.

Finally, several limitations of our study should be taken into account. The first and most notable one is the questionable variability in the dependent variables, which implies that only a small portion of the possible specter of physical distancing, hygiene maintenance, and COVID-19 policy support was measured in this study. This is not unusual as the data were collected during the full-blown first wave of the COVID-19 pandemic, with lockdowns and financial penalties for violating imposed restrictions, defining everyday life and behavior. Also, although, in most cases, at least some of the restrictive measures were in force, specific policies varied across countries and regions. We tried to counter this problem by eliminating countries with insufficient variability from the analyses, which resulted in a greatly reduced number of countries, primarily WEIRD societies (Henrich et al., 2010). However, this was the only way to protect ecological validity (i.e., that our results reflect real-life phenomena as they occur) without annulling the validity of the applied statistical procedures. Even considering the full sample, comprising of 67 countries/regions, it was simply not possible to ensure representativeness and balanced representation of countries (African and Middle Eastern countries), having in mind the circumstances of a developing pandemic. This obviously presented a crucial obstacle to our intention to examine the relations of the investigated factors in a cross-cultural context.

Once again, we have to note that we deviated from our preregistration regarding the operationalization of political context by not taking into account the confidence intervals when forming the three country groups, although following the principal logic of country grouping based on the correlation between political orientation and policy support. Additionally, we did not preregister our final analyses, exploring the interactions of political ideology and the two indicators of analytic thinking in predicting the three outcome variables in the US and Canadian sample, following Pennycook et al. (2021). The results stemming from these analyses are purely exploratory and have to be treated with caution.

Furthermore, the use of brief versions of instruments may undermine construct validity as even broad phenomena are measured using only several items. This is most notable in the application of CRT, which can, in general, yield two scores: one for the number of correct answers and one for the number of intuitive answers (Frederick, 2005). However, on a set of three items, that we were bound to due to project limitations, it was impossible to extract both results without multicollinearity. Therefore, in the future studies, we would recommend the use of longer measures of cognitive reflection. Consequently, incorporating additional potentially relevant variables, such as trust in science (see for example, Plohl and Musil, 2020), risk perception, attitudes toward vaccination, and other indicators of cognitive capacity and motivation of critical thinking (e.g., scientific reasoning, see Čavojová et al., 2020, science curiosity, see Erceg et al., 2020b), as well as taking into account the dynamic factors, which fluctuate with respect to the time and the phase of the crisis when collecting data, may provide a broader picture in understanding psychological and behavioral responses to the

pandemic. This, of course, implies careful and theory-informed development of potential models.

Since the literature on the effects of social desirability on reporting risk behaviors remains inconclusive (Crutzen and Göriz, 2010; Davis et al., 2010), we would also recommend future researchers to use some measure of overclaiming or social desirability to ensure the robustness of findings.

Ultimately, this was a correlational cross-sectional study, so no causal conclusions should be drawn. As already stated, a longitudinal study that would allow monitoring of public responses to the pandemic during different phases would be of great value, as well as experimental and meta-analytical studies informed by previous work.

CONCLUSIONS

In the current study, within the dual-process framework of human reasoning, we focused on examining political orientation and analytic thinking (cognitive reflection, open-minded thinking) as possible sources of differences in adherence to COVID-19 preventive behaviors (physical distancing and maintaining hygiene) and support for restrictive COVID-19 policies across different countries.

We have not been able to detect substantial relationships of political orientation with preventive behaviors and policy support, and overall found no reliable evidence of politicization nor polarization regarding the issue. The SEM results showed that the inclination toward and endorsement of COVID-19 preventive measures was defined primarily by the tendency of open-minded thinking. Specifically, it was shown to be a predictor of all three criteria: avoiding physical contact, maintaining physical hygiene, and policy support. Cognitive reflection was predictive of lesser adherence to stricter hygiene and weakly to lesser policy support. Furthermore, there was no evidence of these effects varying across political contexts. The mediation analysis suggested a partial mediation effect of COVID-19 conspiracy beliefs on the relationships of open-mindedness and CRT with physical distancing (but not adherence to stricter hygiene) and COVID-19 policy support, albeit very small and significant primarily due to the sample size. There was also no evidence of these effects varying across political contexts. Finally, we have not been able to find strong evidence of political orientation modifying the relationship between analytical thinking and COVID-19 behaviors and policy support, although we explored the pattern of these effects in the US and Canadian sample for exploratory purposes and comparison with findings of Pennycook et al. (2021).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics and Governance Committee, University of Kent. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All the authors made substantial contributions to the theoretical framework, design, data collection, interpretation of this study, contributed to this article and approved its publication, and agreed to be accountable for the accuracy and integrity of the project.

REFERENCES

- Aaronovitch, D. (2009). *Voodoo Histories: The Role of the Conspiracy Theory in Shaping Modern History*. London: Jonathan Cape.
- Albertson, B., and Gadarian, S. K. (2015). *Anxious Politics: Democratic Citizenship in a Threatening World*. New York, NY: Cambridge University Press.
- Alfano, M., Iurino, K., Stey, P., Robinson, B., Christen, M., Yu, F., et al. (2017). Development and validation of a multi-dimensional measure of intellectual humility. *PLoS ONE* 12:e0182950. doi: 10.1371/journal.pone.0182950
- Allcott, H., Boxell, L., Conway, J. C., Gentzkow, M., Thaler, M., and Yang, D. Y. (2020). Polarization and public health: partisan differences in social distancing during the coronavirus pandemic. *J. Public Econ.* 191:104254. doi: 10.1016/j.jpubeco.2020.104254
- Alper, S., Bayrak, F., and Yilmaz, O. (2020). Psychological correlates of COVID-19 conspiracy beliefs and preventive measures: evidence from Turkey. *Curr. Psychol.* doi: 10.1007/s12144-020-00903-0. [Epub ahead of print].
- Andersen, M. (2020). Early evidence on social distancing in response to COVID-19 in the United States. *SSRN Electron. J.* doi: 10.2139/ssrn.3569368
- Armitage, C. J., and Conner, M. (2001). Efficacy of the theory of planned behaviour: a meta-analytic review. *Br. J. Soc. Psychol.* 40, 471–499. doi: 10.1348/014466601164939
- Bago, B., Rand, D. G., and Pennycook, G. (2020). Fake news, fast and slow: deliberation reduces belief in false (but not true) news headlines. *J. Exp. Psychol. Gen.* 149, 1608–1613. doi: 10.1037/xge0000729
- Baron, J. (1985). "What kinds of intelligence components are fundamental?", in *Thinking and Learning Skills: Vol. II, Research and Open Questions*, eds. S. F. Chipman, J. W. Segal, and R. Glaser (Hillsdale, NJ: Lawrence Erlbaum), 365–390.
- Baron, J. (2017). Comment on Kahan and Corbin: can polarization increase with actively open-minded thinking? *Res. Politics* 4, 1–4. doi: 10.1177/2053168016688122
- Baron, J. (2019). Actively open-minded thinking in politics. *Cognition* 188, 8–18. doi: 10.1016/j.cognition.2018.10.004
- Baron, J., Scott, S., Fincher, K., and Emlen Metz, S. (2015). Why does the Cognitive Reflection Test (sometimes) predict utilitarian moral judgment (and other things)? *J. Appl. Res. Mem. Cogn.* 4, 265–284. doi: 10.1016/j.jarmac.2014.09.003
- Barrios, J., and Hochberg, Y. (2020). *Risk Perception Through the Lens of Politics in the Time of the COVID-19 Pandemic (No. 27008)*. Available online at: <https://ssrn.com/abstract=3580566> (accessed August 8, 2020).
- Bierwaczek, K., Kunst, J. R., and Pich, O. (2020). Belief in COVID-19 conspiracy theories reduces social distancing over time. *Appl. Psychol. Hlth. We* 12, 1270–1285. doi: 10.1111/aphw.12223
- Bish, A., and Michie, S. (2010). Demographic and attitudinal determinants of protective behaviours during a pandemic: a review. *Br. J. Health. Psychol.* 15, 797–824. doi: 10.1348/135910710X485826
- Bogart, L. M., Wagner, G., Galvan, F. H., and Banks, D. (2010). Conspiracy beliefs about HIV are related to antiretroviral treatment nonadherence among

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.631800/full#supplementary-material>

- African American men with HIV. *J. Acquir. Immune Defic. Syndr.* 53, 648–655. doi: 10.1097/QAI.0b013e3181c57dbc
- Bolsen, T., and Druckman, J. N. (2018). Do partisanship and politicization undermine the impact of a scientific consensus message about climate change? *Group Process Intergroup Relat.* 21, 389–402. doi: 10.1177/1368430217737855
- Bolsen, T., Druckman, J. N., and Cook, F. L. (2014). The influence of partisan motivated reasoning on public opinion. *Polit. Behav.* 36, 235–262. doi: 10.1007/s11109-013-9238-0
- Bolsen, T., Druckman, J. N., and Cook, F. L. (2015). Citizens', scientists', and policy advisors' beliefs about global warming. *Ann. Am. Acad. Pol. Soc. Sci.* 658, 271–295. doi: 10.1177/0002716214558393
- Bronstein, M. V., Pennycook, G., Bear, A., Rand, D. G., and Cannon, T. D. (2019). Belief in fake news is associated with delusionality, dogmatism, religious fundamentalism, and reduced analytic thinking. *J. Appl. Res. Mem. Cogn.* 8, 108–117. doi: 10.1016/j.jarmac.2018.09.005
- Browne, M., Thomson, P., Rockloff, M. J., and Pennycook, G. (2015). Going against the herd: psychological and cultural factors underlying the 'vaccination confidence gap'. *PLoS ONE* 10:e0132562. doi: 10.1371/journal.pone.0132562
- Bruder, M., Haffke, P., Neave, N., Nouripanah, N., and Imhoff, R. (2013). Measuring individual differences in generic beliefs in conspiracy theories across cultures: Conspiracy Mentality Questionnaire. *Front. Psychol.* 4:225. doi: 10.3389/fpsyg.2013.00225
- Calvillo, D. P., Ross, B. J., Garcia, R. J., Smelter, T. J., and Rutchick, A. M. (2020). Political ideology predicts perceptions of the threat of covid-19 (and susceptibility to fake news about it). *Soc. Psychol. Personal. Sci.* 11, 1119–1128. doi: 10.1177/1948550620940539
- Campitelli, G., and Gerrans, P. (2014). Does the cognitive reflection test measure cognitive reflection? A mathematical modeling approach. *Mem. Cogn.* 42, 434–447. doi: 10.3758/s13421-013-0367-9
- Capraro, V., Corgnet, B., Espín, A. M., and Hernán-González, R. (2017). Deliberation favours social efficiency by making people disregard their relative shares: evidence from USA and India. *R. Soc. Open Sci.* 4:160605. doi: 10.1098/rsos.160605
- Čavojská, V., Šrol, J., and Ballová Mikušková, E. (2020). How scientific reasoning correlates with health-related beliefs and behaviors during the COVID-19 pandemic? *J. Health Psychol.* doi: 10.1177/1359105320962266. [Epub ahead of print].
- Chen, C. C., Chiu, I. M., Smith, J., and Yamada, T. (2013). Too smart to be selfish? Measures of cognitive ability, social preferences, and consistency. *J. Econ. Behav. Organ.* 90, 112–122. doi: 10.1016/j.jebo.2013.03.032
- Choma, B. L., Hodson, G., Sumantry, D., Hanoch, Y., and Gummerum, M. (2021). Ideological and psychological predictors of COVID-19-related collective action, opinions, and health compliance across three nations. *J. Soc. Polit. Psychol.* 9, 123–143. doi: 10.5964/jsp.5585
- Clark, C., Davila, A., Regis, M., and Kraus, S. (2020). Predictors of COVID-19 voluntary compliance behaviors: an international investigation. *Glob. Transit.* 2, 76–82. doi: 10.1016/j.glt.2020.06.003

- Cokely, E. T., and Kelley, C. M. (2009). Cognitive abilities and superior decision making under risk: a protocol analysis and process model evaluation. *Judgm. Decis. Mak.* 4, 20–33.
- Conway, L. G., III, Woodard, S. R., Zubrod, A., and Chan, L. (2021). Why are conservatives less concerned about the coronavirus (covid-19) than liberals? Comparing political, experiential, and partisan messaging explanations. *PsyArXiv* [preprint, version 2]. doi: 10.31234/osf.io/fgb84
- Crutzen, R., and Göritz, A. S. (2010). Social desirability and self-reported health risk behaviors in web-based research: three longitudinal studies. *BMC Public Health* 10:720. doi: 10.1186/1471-2458-10-720
- Davis, C. G., Thake, J., and Vilhena, N. (2010). Social desirability biases in self-reported alcohol consumption and harms. *Addict. Behav.* 35, 302–311. doi: 10.1016/j.addbeh.2009.11.001
- De Neys, W. (2014). Conflict detection, dual processes, and logical intuitions: some clarifications. *Think. Reason.* 20, 169–187. doi: 10.1080/13546783.2013.854725
- Douglas, K. M., and Sutton, R. M. (2008). The hidden impact of conspiracy theories: perceived and actual influence of theories surrounding the death of Princess Diana. *J. Soc. Psychol.* 148, 210–222. doi: 10.3200/SOCP.148.2.210-222
- Drummond, C., and Fischhoff, B. (2017). Individuals with greater science literacy and education have more polarized beliefs on controversial science topics. *Proc. Natl. Acad. Sci. U.S.A.* 114, 9587–9592. doi: 10.1073/pnas.1704882114
- Earnshaw, V. A., Eaton, L. A., Kalichman, S. C., Brousseau, N. M., Hill, E. C., and Fox, A. B. (2020). COVID-19 conspiracy beliefs, health behaviors, and policy support. *Transl. Behav. Med.* 10, 850–856. doi: 10.1093/tbm/ibaa090
- Engle, S., Stromme, J., and Zhou, A. (2020). “Staying at home: mobility effects of COVID-19,” in *COVID Economics Vetted and Real-Time Papers*, Vol. 4, 86–102. Available online at: <https://iris.unibocconi.it/retrieve/handle/11565/4026151/122470/COVIDEconomics4.pdf#page=90>
- Erceg, N., and Bubić, A. (2017). One test, five scoring procedures: different ways of approaching the cognitive reflection test. *J. Cogn. Psychol.* 29, 381–392. doi: 10.1080/20445911.2016.1278004
- Erceg, N., Galić, Z., and Ružojić, M. (2020a). A reflection on cognitive reflection-testing convergent/divergent validity of two measures of cognitive reflection. *Judgm. Decis. Mak.* 15, 741–755.
- Erceg, N., Ružojić, M., and Galić, Z. (2020b). Misbehaving in the Corona crisis: the role of anxiety and unfounded beliefs. *Curr. Psychol.* doi: 10.1007/s12144-020-01040-4. [Epub ahead of print].
- Evans, J., St. B. T., and Stanovich, K. E. (2013). Dual-process theories of higher cognition: advancing the debate. *Perspect. Psychol. Sci.* 8, 223–241. doi: 10.1177/1745691612460685
- Evans, J. St. B. T., and Frankish, K. (eds.). (2009). *In Two Minds: Dual Processes and Beyond*. Oxford: Oxford University Press.
- Everett, J. A., Ingbretsen, Z., Cushman, F., and Cikara, M. (2017). Deliberation erodes cooperative behavior—even towards competitive out-groups, even when using a control condition, and even when eliminating selection bias. *J. Exp. Soc. Psychol.* 73, 76–81. doi: 10.1016/j.jesp.2017.06.014
- Frederick, S. (2005). Cognitive reflection and decision making. *J. Econ. Perspect.* 19, 25–42. doi: 10.1257/089533005775196732
- Gaertner, S.L., and Dovidio, J. F. (2012). “The common ingroup identity model”, in *Handbook of Theories of Social Psychology*, Vol. 2. eds P. A. M. Van Lange, A. W. Kruglanski, and E. T. Higgins (Thousand Oaks, CA: Sage), 439–457.
- Gelman, A. (2018). *You Need 16 Times the Sample Size to Estimate an Interaction Than to Estimate a Main Effect*. Available online at: <https://statmodeling.stat.columbia.edu/2018/03/15/need-16-times-sample-size-estimate-interaction-estimate-main-effect/#comment-685111/>
- Georgiou, N., Delfabbro, P., and Balzan, R. (2019). Conspiracy beliefs in the general population: the importance of psychopathology, cognitive style and educational attainment. *Pers. Individ. Differ.* 151:109521. doi: 10.1016/j.paid.2019.109521
- Gignac, G. E., and Szodorai, E. T. (2016). Effect size guidelines for individual differences researchers. *Personal. Individ. Differ.* 102, 74–78. doi: 10.1016/j.paid.2016.06.069
- Goertzel, T. (1994). Belief in conspiracy theories. *Polit. Psychol.* 15, 731–742. doi: 10.2307/3791630
- Gollwitzer, A., Martel, C., Brady, W. J., Knowles, E. D., and Van Bavel, J. (2020). Partisan differences in physical distancing are linked to health outcomes during the COVID-19 pandemic. *Nat. Hum. Behav.* 4, 1186–1197. doi: 10.1038/s41562-020-00977-7
- Grebe, E., and Natrass, N. (2012). AIDS conspiracy beliefs and unsafe sex in Cape Town. *AIDS Behav.* 16, 761–773. doi: 10.1007/s10461-011-9958-2
- Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., et al. (2021). A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). *Nat. Hum. Behav.* 5, 529–538. doi: 10.1038/s41562-021-01079-8
- Hamilton, L. C., Cutler, M. J., and Schaefer, A. (2012). Public knowledge and concern about polar-region warming. *Polar Geogr.* 35, 155–168. doi: 10.1080/1088937X.2012.684155
- Haran, U., Ritov, I., and Mellers, B. A. (2013). The role of actively open-minded thinking in information acquisition, accuracy, and calibration. *Judgm. Decis. Mak.* 8, 188–201.
- Harper, C. A., Satchell, L. P., Fido, D., and Latzman, R. D. (2020). Functional fear predicts public health compliance in the COVID-19 pandemic. *Int. J. Ment. Health Addiction.* doi: 10.1007/s11469-020-00281-5. [Epub ahead of print].
- Hart, P. S., and Nisbet, E. C. (2012). Boomerang effects in science communication: how motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Commun. Res.* 39, 701–723. doi: 10.1177/0093650211416646
- Heijltjes, A., Van Gog, T., Leppink, J., and Paas, F. (2014). Improving critical thinking: effects of dispositions and instructions on economics students’ reasoning skills. *Learn. Instr.* 29, 31–42. doi: 10.1016/j.learninstruc.2013.07.003
- Henrich, J., Heine, S. J., and Norenzayan, A. (2010). Most people are not WEIRD. *Nature* 466:29. doi: 10.1038/466029a
- Ho, S. S., Brossard, D., and Scheufele, D. A. (2008). Effects of value predispositions, mass media use, and knowledge on public attitudes toward embryonic stem cell research. *Int. J. Public Opin. Res.* 20, 171–192. doi: 10.1093/ijpor/edn017
- Hoppe, E. I., and Kusterer, D. J. (2011). Behavioral biases and cognitive reflection. *Econ. Lett.* 110, 97–100. doi: 10.1016/j.econlet.2010.11.015
- Hudiyana, J., Putra, I., Ariyanto, A., Brama, G., and Muluk, H. (2019). Can the activation of analytic cognitive style determine endorsement of secular belief? *J. Pac. Rim. Psychol.* 13:E30. doi: 10.1017/prp.2019.23
- Imhoff, R., and Bruder, M. (2014). Speaking (un-) truth to power: conspiracy mentality as a generalised political attitude. *Eur. J. Personal.* 28, 25–43. doi: 10.1002/per.1930
- Imhoff, R., and Lamberty, P. (2020). A bioweapon or a hoax? The link between distinct conspiracy beliefs about the coronavirus disease (COVID-19) outbreak and pandemic behavior. *Soc. Psychol. Personal. Sci.* 11, 1110–1118. doi: 10.1177/1948550620934692
- Jolley, D., and Douglas, K. M. (2014). The effects of anti-vaccine conspiracy theories on vaccination intentions. *PLoS ONE* 9:e89177. doi: 10.1371/journal.pone.0089177
- Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., and Rosseel, Y. (2020). *semTools: Useful Tools for Structural Equation Modeling. R Package Version 0.5-3*. Available online at: <https://CRAN.R-project.org/package=semTools>
- Kahan, D. M. (2013). Ideology, motivated reasoning, and cognitive reflection. *Judgm. Decis. Mak.* 8, 407–424.
- Kahan, D. M. (2017a). Misconceptions, misinformation, and the logic of identity-protective cognition. *SSRN Electron. J.* doi: 10.2139/ssrn.2973067
- Kahan, D. M. (2017b). The expressive rationality of inaccurate perceptions. *Behav. Brain. Sci.* 40:e6. doi: 10.1017/S0140525X15002332
- Kahan, D. M., Braman, D., Cohen, G. L., Gastil, J., and Slovic, P. (2010a). Who fears the HPV vaccine, who doesn’t, and why? An experimental study of the mechanisms of cultural cognition. *Law. Hum. Behav.* 34, 501–516. doi: 10.1007/s10979-009-9201-0
- Kahan, D. M., Braman, D., Gastil, J., Slovic, P., and Mertz, C. K. (2007). Culture and identity-protective cognition: explaining the white-male effect in risk perception. *J. Empir. Leg. Stud.* 4, 465–505. doi: 10.1111/j.1740-1461.2007.00097.x
- Kahan, D. M., Braman, D., Monahan, J., Callahan, L., and Peters, E. (2010b). Cultural cognition and public policy: the case of outpatient commitment laws. *Law Human Behav.* 34, 118–140. doi: 10.1007/s10979-008-9174-4
- Kahan, D. M., and Corbin, J. C. (2016). A note on the perverse effects of actively open-minded thinking on climate-change polarization. *Res. Polit.* 3, 1–5. doi: 10.1177/2053168016676705

- Kahan, D. M., Jenkins-Smith, H., and Braman, D. (2011). Cultural cognition of scientific consensus. *J. Risk Res.* 14, 147–174. doi: 10.1080/13669877.2010.511246
- Kahan, D. M., Peters, E., Dawson, E. C., and Slovic, P. (2017). Motivated numeracy and enlightened self-government. *Behav. Public Policy* 1, 54–86. doi: 10.1017/bpp.2016.2
- Kahan, D. M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L.L., Braman, D., et al. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nat. Clim. Change* 2, 732–735. doi: 10.1038/nclimate1547
- Kahneman, D. (2011). *Thinking, Fast and Slow*. New York, NY: Farrar, Straus & Giroux.
- Kerr, J., Panagopoulos, C., and van der Linden, S. (2021). Political polarization on COVID-19 pandemic response in the United States. *Pers. Individ. Differ.* 179:110892. doi: 10.1016/j.paid.2021.110892
- Koehler, D. J., and James, G. (2010). Probability matching and strategy availability. *Mem. Cognit.* 38, 667–676. doi: 10.3758/MC.38.6.667
- Kunda, Z. (1990). The case for motivated reasoning. *Psychol. Bull.* 108, 480–498. doi: 10.1037/0033-2909.108.3.480
- Kushner Gadarian, S., Goodman, S. W., and Pepinsky, T. B. (2021). Partisanship, health behavior, and policy attitudes in the early stages of the COVID-19 pandemic. *PLoS ONE* 16:e0249596. doi: 10.1371/journal.pone.0249596
- Leeper, T. J., and Slothuus, R. (2014). Political parties, motivated reasoning, and public opinion formation. *Polit. Psychol.* 35, 129–156. doi: 10.1111/pops.12164
- Lesage, E., Navarrete, G., and De Neys, W. (2013). Evolutionary modules and Bayesian facilitation: the role of general cognitive resources. *Think. Reason.* 19, 27–53. doi: 10.1080/13546783.2012.713177
- Lewandowsky, S., Gignac, G. E., and Vaughan, S. (2012). The pivotal role of perceived scientific consensus in acceptance of science. *Nat. Clim. Chang.* 3, 399–404. doi: 10.1038/nclimate1720
- Lewandowsky, S., Oberauer, K., and Gignac, G. E. (2013). NASA faked the moon landing—therefore, (climate) science is a hoax: an anatomy of the motivated rejection of science. *Psychol. Sci.* 24, 622–633. doi: 10.1177/0956797612457686
- Lord, C. G., Ross, L., and Lepper, M. R. (1979). Biased assimilation and attitude polarization: the effects of prior theories on subsequently considered evidence. *J. Pers. Soc. Psychol.* 37, 2098–2109. doi: 10.1037/0022-3514.37.11.2098
- Lunn, P. D., Belton, C. A., Lavin, C., McGowan, F. P., Timmons, S., and Robertson, D. A. (2020). Using behavioral science to help fight the coronavirus. *J. Behav. Public Admin.* 3, 1–15. doi: 10.30636/jbpa.31.147
- Majima, Y. (2015). Belief in pseudoscience, cognitive style and science literacy. *Appl. Cogn. Psychol.* 29, 552–559. doi: 10.1002/acp.3136
- McClelland, G. H., and Judd, C. M. (1993). Statistical difficulties of detecting interactions and moderator effects. *Psychol. Bull.* 114, 376–390. doi: 10.1037/0033-2909.114.2.376
- McEachan, R. R. C., Conner, M., Taylor, N. J., and Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: a meta-analysis. *Health. Psychol. Rev.* 5, 97–144. doi: 10.1080/17437199.2010.521684
- McPhetres, J., Bago, B., and Pennycook, G. (2021). Science beliefs, political ideology, and cognitive sophistication. OSF [preprint, version 5]. doi: 10.31219/osf.io/ad9v7
- Mosleh, M., Pennycook, G., Arechar, A. A., and Rand, D. G. (2021). Cognitive reflection correlates with behavior on Twitter. *Nat. Commun.* 12:921. doi: 10.1038/s41467-020-20043-0
- Motta, M. (2018). The enduring effect of scientific interest on trust in climate scientists in the United States. *Nat. Clim. Chang.* 8, 485–488. doi: 10.1038/s41558-018-0126-9
- Nisbet, M. C. (2005). The competition for worldviews: values, information, and public support for stem cell research. *Int. J. Public Opin. Res.* 17, 90–112. doi: 10.1093/ijpor/edh058
- Oechssler, J., Roider, A., and Schmitz, P. W. (2009). Cognitive abilities and behavioral biases. *J. Econ. Behav. Organ.* 72, 147–152. doi: 10.1016/j.jebo.2009.04.018
- Oliver, J. E., and Wood, T.J. (2014b). Medical conspiracy theories and health behaviors in the United States. *JAMA Intern. Med.* 174, 817–818. doi: 10.1001/jamainternmed.2014.190
- Oliver, J. E., and Wood, T. J. (2014a). Conspiracy theories and the paranoid style(s) of mass opinion. *Am. J. Pol. Sci.* 58, 952–966. doi: 10.1111/ajps.12084
- Painter, M., and Qiu, T. (2021). Political beliefs affect compliance with government mandates. *J. Econ. Behav. Organ.* 185, 688–701. doi: 10.1016/j.jebo.2021.03.019
- Pavela Banai, I., Banai, B., and Mikloušić, I. (2021). Beliefs in COVID-19 conspiracy theories, compliance with the preventive measures, and trust in government medical officials. *Curr. Psychol.* doi: 10.1007/s12144-021-01898-y. [Epub ahead of print].
- Pennycook, G. (2018). *The New Reflectionism in Cognitive Psychology: Why Reason Matters*. New York, NY: Routledge.
- Pennycook, G., Cheyne, J. A., Barr, N., Koehler, D. J., and Fugelsang, J. A. (2014). Cognitive style and religiosity: the role of conflict detection. *Mem. Cognit.* 42, 1–10. doi: 10.3758/s13421-013-0340-7
- Pennycook, G., Cheyne, J. A., Barr, N., Koehler, D. J., and Fugelsang, J. A. (2015a). On the reception and detection of pseudo-profound bullshit. *Judgm. Decis. Mak.* 10, 549–563.
- Pennycook, G., Cheyne, J. A., Koehler, D. J., and Fugelsang, J. A. (2020a). On the belief that beliefs should change according to evidence: implications for conspiratorial, moral, paranormal, political, religious, and science beliefs. *Judgm. Decis. Mak.* 15, 476–498.
- Pennycook, G., Fugelsang, J. A., and Koehler, D. J. (2015b). Everyday consequences of analytic thinking. *Curr. Dir. Psychol. Sci.* 24, 425–432. doi: 10.1177/0963721415604610
- Pennycook, G., Fugelsang, J. A., and Koehler, D. J. (2015c). What makes us think? A three-stage dual-process model of analytic engagement. *Cogn. Psychol.* 80, 34–72. doi: 10.1016/j.cogpsych.2015.05.001
- Pennycook, G., McPhetres, J., Bago, B., and Rand, D. G. (2021). Beliefs about COVID-19 in Canada, the United Kingdom, and the United States: A novel test of political polarization and motivated reasoning. *Pers. Soc. Psychol. Bull.* doi: 10.1177/01461672211023652
- Pennycook, G., McPhetres, J., Zhang, Y., Lu, J. G., and Rand, D. G. (2020b). Fighting COVID-19 misinformation on social media: experimental evidence for a scalable accuracy-nudge intervention. *Psychol. Sci.* 31, 770–780. doi: 10.1177/0956797620939054
- Pennycook, G., and Rand, D. G. (2019). Lazy, not biased: susceptibility to partisan fake news is better explained by lack of reasoning than by motivated reasoning. *Cognition* 188, 39–50. doi: 10.1016/j.cognition.2018.06.011
- Pennycook, G., and Ross, M. R. (2016). Commentary: cognitive reflection vs. calculation indecision making. *Front. Psychol.* 7:9. doi: 10.3389/fpsyg.2016.00009
- Pennycook, G., Ross, R. M., Koehler, D. J., and Fugelsang, J. A. (2017). Dunning-Kruger effects in reasoning: theoretical implications of the failure to recognize incompetence. *Psychon. Bull. Rev.* 24, 1774–1784. doi: 10.3758/s13423-017-1242-7
- Pew Research Center (2018a). *Gun Policy Remains Divisive, But Several Proposals Still Draw Bipartisan Support*. Available online at: <https://www.people-press.org/wp-content/uploads/sites/4/2018/10/Guns-report-for-release-upt.pdf> (accessed April 27, 2021).
- Pew Research Center (2018b). *Majorities See Government Efforts to Protect the Environment as Insufficient*. Washington, DC: Pew Research Center. Available online at: https://www.pewresearch.org/science/wp-content/uploads/sites/16/2018/05/PS_2018.05.14_energyclimate_FINAL.pdf (accessed April 27, 2021).
- Pew Research Center (2020a). *Partisan Differences Over the Pandemic Response Are Growing*. Washington, DC: Pew Research Center. Available online at: <https://www.pewresearch.org/science/2020/06/03/partisan-differences-over-the-pandemic-response-are-growing/> (accessed April 27, 2021).
- Pew Research Center (2020b). *U.S. Public Sees Multiple Threats From the Coronavirus – and Concerns Are Growing*. Washington, DC: Pew Research Center. Available online at: <https://www.pewresearch.org/politics/2020/03/18/u-s-public-sees-multiple-threats-from-the-coronavirus-and-concerns-are-growing/> (accessed April 27, 2021).
- Pickup, M., Stecula, D., and Van der Linden, C. (2020). Novel coronavirus, old partisanship: COVID-19 attitudes and behaviours in the United States and Canada. *Can. J. Polit. Sci.* 53, 357–364. doi: 10.1017/S0008423920000463
- Plohl, N., and Musil, B. (2020). Modeling compliance with COVID-19 prevention guidelines: the critical role of trust in science. *Psychol. Health. Med.* 26, 1–12. doi: 10.1080/13548506.2020.1772988

- Pummerer, L., Böhm, R., Lilleholt, L., Winter, K., Zettler, I., and Sassenberg, K. (2021). Conspiracy theories and their societal effects during the COVID-19 pandemic. *Soc. Psychol. Pers. Sci.* doi: 10.1177/19485506211000217. [Epub ahead of print].
- Qian, K., and Yahara, T. (2020). Mentality and behavior in COVID-19 emergency status in Japan: influence of personality, morality and ideology. *PLoS ONE* 15:e0235883. doi: 10.1371/journal.pone.0235883
- R Core Team (2020). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing. Available online at: <https://www.R-project.org/>
- Rand, D., Greene, J., and Nowak, M. (2012). Spontaneous giving and calculated greed. *Nature* 489, 427–430. doi: 10.1038/nature11467
- Rand, D. G. (2016). Cooperation, fast and slow: meta-analytic evidence for a theory of social heuristics and self-interested deliberation. *Psychol. Sci.* 27, 1192–1206. doi: 10.1177/0956797616654455
- Rand, D. G., Peysakhovich, A., Kraft-Todd, G. T., Newman, G. E., Wurzbacher, O., Nowak, M. A., et al. (2014). Social heuristics shape intuitive cooperation. *Nat. Commun.* 5:3677. doi: 10.1038/ncomms4677
- Raoelison, M. T., Thompson, V. A., and De Neys, W. (2020). The smart intuitor: cognitive capacity predicts intuitive rather than deliberate thinking. *Cognition* 204:104381. doi: 10.1016/j.cognition.2020.104381
- Raude, J., Lecrique, J. M., Lasbeur, L., Leon, C., Guignard, R., Roscoät, E. D., et al. (2020). Determinants of preventive behaviors in response to the COVID-19 pandemic in France: comparing the sociocultural, psychosocial, and social cognitive explanations. *Front. Psychol.* 11:584500. doi: 10.3389/fpsyg.2020.584500
- Risen, J. L. (2016). Believing what we do not believe: acquiescence to superstitious beliefs and other powerful intuitions. *Psychol. Rev.* 123, 182–207. doi: 10.1037/rev0000017
- Rizeq, J., Flora, D. B., and Toplak, M. E. (2021). An examination of the underlying dimensional structure of three domains of contaminated mindware: paranormal beliefs, conspiracy beliefs, and anti-science attitudes. *Think. Reason.* 27, 187–211. doi: 10.1080/13546783.2020.1759688
- Rosseel, Y. (2012). lavaan: an R package for structural equation modeling. *J. Stat. Softw.* 48, 1–36. doi: 10.18637/jss.v048.i02
- Rothgerber, H., Wilson, T., Whaley, D., Rosenfeld, D. L., Humphrey, M., Moore, A. L., et al. (2020). Politicizing the COVID-19 pandemic: ideological differences in adherence to social distancing. *PsyArXiv* [preprint, version 1]. doi: 10.31234/osf.io/k23cv
- Sá, W. C., West, R. F., and Stanovich, K. E. (1999). The domain specificity and generality of belief bias: searching for a generalizable critical thinking skill. *J. Educ. Psychol.* 91, 497–510. doi: 10.1037/0022-0663.91.3.497
- Saad, L. (2020). *Americans Less Amenable to Another COVID-19 Lockdown*. Gallup. Available online at: <https://news.gallup.com/poll/324146/americans-less-amenable-covid-lockdown.aspx> (accessed April 25, 2021).
- Sabat, I., Neuman-Böhme, S., Varghese, N. E., Barros, P. P., Brouwer, W., van Exel, J., et al. (2020). United but divided: policy responses and people's perceptions in the EU during the COVID-19 outbreak. *Health Policy* 124, 909–918. doi: 10.1016/j.healthpol.2020.06.009
- Sarathchandra, D., Navin, M. C., Largent, M. A., and McCright, A. M. (2018). A survey instrument for measuring vaccine acceptance. *Prev. Med.* 109, 1–7. doi: 10.1016/j.ypmed.2018.01.006
- Schellhaas, F. M. H., and Dovidio, J. F. (2016). Improving intergroup relations. *Curr. Opin. Psychol.* 11, 10–14. doi: 10.1016/j.copsyc.2016.04.002
- Simmons, K., Silver, L., Johnson, C., Taylor, K., and Wike, R. (2018). *Stark Left-Right Divides on Attitudes about Immigration*. Washington, DC: Pew Research Center. Available online at: <https://www.pewresearch.org/global/2018/07/12/stark-left-right-divides-on-attitudes-about-immigration/> (accessed April 27, 2021).
- Sirota, M., Juanchich, M., and Haggmayer, Y. (2014). Ecological rationality or nested sets? Individual differences in cognitive processing predict Bayesian reasoning. *Psychon. Bull. Rev.* 21, 198–204. doi: 10.3758/s13423-013-0464-6
- Stanley, M. L., Barr, N., Peters, K., and Seli, P. (2020). Analytic-thinking predicts hoax beliefs and helping behaviors in response to the COVID-19 pandemic. *Think. Reason.* doi: 10.1080/13546783.2020.1813806. [Epub ahead of print].
- Stanovich, K. (2012). “On the distinction between rationality and intelligence: implications for understanding individual differences in reasoning”, in *The Oxford Handbook of Thinking and Reasoning*. eds K. J. Holyoak and R. G. Morrison (New York, NY: Oxford University Press), 343–365.
- Stanovich, K. E. (2003). “The fundamental computational biases of human cognition: heuristics that (sometimes) impair decision making and problem solving”, in *The Psychology of Problem Solving*, eds J. E. Davidson and R. J. Sternberg (New York, NY: Cambridge University Press), 291–342.
- Stanovich, K. E. (2004). *The Robot's Rebellion: Finding Meaning in the Age of Darwin*. Chicago, IL: University of Chicago Press.
- Stanovich, K. E. (2011). *Rationality and the Reflective Mind*. New York, NY: Oxford University Press.
- Stanovich, K. E. (2015). Rational and irrational thought: the thinking that IQ tests miss. *Sci. Am. Mind Spec. Collect. Ed.* 23, 12–17. doi: 10.1038/scientificamericangenius0115-12
- Stanovich, K. E., and West, R. F. (1997). Reasoning independently of prior belief and individual differences in actively open-minded thinking. *J. Educ. Psychol.* 89, 342–357. doi: 10.1037/0022-0663.89.2.342
- Stanovich, K. E., and West, R. F. (2000). Individual differences in reasoning: implications for the rationality debate? *Behav. Brain Sci.* 23, 645–726. doi: 10.1017/S0140525X00003435
- Stanovich, K. E., and West, R. F. (2007). Natural myside bias is independent of cognitive ability. *Think. Reason.* 13, 225–247. doi: 10.1080/13546780600780796
- Stanovich, K. E., West, R. F., and Toplak, M. E. (2016). *The Rationality Quotient: Toward a Test of Rational Thinking*. Cambridge: MIT Press.
- Sutton, R. M., and Douglas, K. M. (2014). “Examining the monological nature of conspiracy theories”, in *Power, Politics, and Paranoia*, eds J. W. van Prooijen and P. A. M. van Lange (Cambridge: Cambridge University Press), 254–272.
- Svedholm-Häkkinen, A. M., and Lindeman, M. (2018). Actively open-minded thinking: development of a shortened scale and disentangling attitudes towards knowledge and people. *Think. Reason.* 24, 21–40. doi: 10.1080/13546783.2017.1378723
- Swami, V., and Barron, D. (2020). Analytic thinking, rejection of coronavirus (COVID-19) conspiracy theories, and compliance with mandated social-distancing: direct and indirect relationships in a nationally representative sample of adults in the United Kingdom. *OSF* [preprint, version 1]. doi: 10.31219/osf.io/nmx9w
- Swami, V., Barron, D., Weis, L., Voracek, M., Stieger, S., and Furnham, A. (2017). An examination of the factorial and convergent validity of four measures of conspiracist ideation, with recommendations for researchers. *PLoS ONE* 12:e0172617. doi: 10.1371/journal.pone.0172617
- Swami, V., Chamorro-Premuzic, T., and Furnham, A. (2010). Unanswered questions: a preliminary investigation of personality and individual difference predictors of 9/11 conspiracist beliefs. *Appl. Cogn. Psychol.* 24, 749–761. doi: 10.1002/acp.1583
- Swami, V., Voracek, M., Stieger, S., Tran, U. S., and Furnham, A. (2014). Analytic thinking reduces belief in conspiracy theories. *Cognition* 133, 572–585. doi: 10.1016/j.cognition.2014.08.006
- Szaszi, B., Szollosi, A., Palfi, B., and Aczel, B. (2017). The cognitive reflection test revisited: exploring the ways individuals solve the test. *Think. Reason.* 23, 207–234. doi: 10.1080/13546783.2017.1292954
- Taber, C. S., and Lodge, M. (2006). Motivated skepticism in the evaluation of political beliefs. *Am. J. Pol. Sci.* 50, 755–769. doi: 10.1111/j.1540-5907.2006.00214.x
- Ten Berge, J. M. F. (1977). Orthogonal Procrustes rotation for two or more matrices. *Psychometrika* 42, 267–276. doi: 10.1007/BF02294053
- Teovanović, P., Lukić, P., Zupan, Z., Lazić, A., Ninković, M., and Žeželj, I. (2021). Irrational beliefs differentially predict adherence to guidelines and pseudoscientific practices during the COVID-19 pandemic. *Appl. Cogn. Psychol.* 35, 486–496. doi: 10.1002/acp.3770
- Thoma, V., Weiss-Cohen, L., Filkuková, P., and Ayton, P. (2021). Cognitive predictors of precautionary behavior during the COVID-19 pandemic. *Front. Psychol.* 12:589800. doi: 10.3389/fpsyg.2021.589800
- Thomson, K. S., and Oppenheimer, D. M. (2016). Investigating an alternate form of the Cognitive Reflection Test. *Judgm. Decis. Mak.* 11, 99–113. doi: 10.1037/t49856-000
- Toplak, M. E., West, R. F., and Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. *Mem. Cogn.* 39, 1275–1289. doi: 10.3758/s13421-011-0104-1

- Toplak, M. E., West, R. F., and Stanovich, K. E. (2014). Assessing miserly information processing: an expansion of the Cognitive Reflection Test. *Think. Reason.* 20, 147–168. doi: 10.1080/13546783.2013.844729
- Trippas, D., Pennycook, G., Verde, M. F., and Handley, S. J. (2015). Better but still biased: analytic cognitive style and belief bias. *Think. Reason.* 21, 431–445. doi: 10.1080/13546783.2015.1016450
- Van Bavel, J. J., Boggio, P., Capraro, V., Cichocka, A., Cikara, M., Crockett, M., et al. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nat. Hum. Behav.* 4, 460–471. doi: 10.1038/s41562-020-0884-z
- van Mulukom, V., Pummerer, L., Alper, S., Bai, H., Čavojová, V., Farias, J. E. M., et al. (2021). COVID-19 conspiracy beliefs are predicted by epistemic and socio-existential motives: a dual pathway model and systematic review. *PsyArXiv* [preprint, version 6]. doi: 10.31234/osf.io/u8yah
- Van Prooijen, J. W. (2017). Why education predicts decreased belief in conspiracy theories. *Appl. Cognit. Psychol.* 31, 50–58. doi: 10.1002/acp.3301
- Vandenberg, R. J., and Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: suggestions, practices, and recommendations for organizational research. *Organ. Res. Methods* 3, 4–70. doi: 10.1177/109442810031002
- Verkoeijen, P. P., and Bouwmeester, S. (2014). Does intuition cause cooperation? *PLoS ONE* 9:e96654. doi: 10.1371/journal.pone.0096654
- Vezzali, L., Cadamuro, A., Versari, A., Giovannini, D., and Trifiletti, E. (2015). Feeling like a group after a natural disaster: common ingroup identity and relations with outgroup victims among majority and minority young children. *Br. J. Soc. Psychol.* 54, 519–538. doi: 10.1111/bjso.12091
- West, R. F., Toplak, M. E., and Stanovich, K. E. (2008). Heuristics and biases as measures of critical thinking: associations with cognitive ability and thinking dispositions. *J. Educ. Psychol.* 100, 930–941. doi: 10.1037/a0012842
- Weston, D., Hauck, K., and Amlôt, R. (2018). Infection prevention behaviour and infectious disease modelling: a review of the literature and recommendations for the future. *BMC Public Health* 18:336. doi: 10.1186/s12889-018-5223-1
- Wismans, A. B., Letina, S., Thurik, R., Wennberg, K., Baptista, R., Barrientos Marín, J., et al. (2020). Hygiene and social distancing as distinct public health related behaviours among university students during the COVID-19 pandemic. *Soc. Psychol. Bull.* 15, 1–26. doi: 10.32872/spb.4383
- Wood, M. J., Douglas, K. M., and Sutton, R. M. (2012). Dead and alive: beliefs in contradictory conspiracy theories. *Soc. Psychol. Personal. Sci.* 3, 767–773. doi: 10.1177/1948550611434786
- World Health Organization (2021). *Coronavirus Disease (COVID-19) Advice for the Public*. Available online at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public> (accessed April 17, 2021).

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Autogenic Training Improves the Subjective Perception of Physical and Psychological Health and of Interpersonal Relational Abilities: An Electronic Field Survey During the COVID-19 Crisis in Spain

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Currently, humanity is facing one of the most critical situations of this century, the COVID-19. The adverse effects of the pandemic on the mental health of the population are well known. Fear of illness, confinement, lack of financial resources, or poor social support can influence people's mental state. Despite these risks, several psychological resources may help address this situation. The present study investigated the effectiveness of a self-relaxation techniques known as autogenic training. Autogenic training is a well-known method in Europe for the treatment of anxiety and stress disorders. The practice of autogenic training is also reported to improve neurovegetative and immune regulation. This study focuses on describing how autogenic training is helping its practitioners to cope with the pandemic. Specifically, they report strong beneficial effects on their physical, psychological, and relational health. In total, 75 autogenic training practitioners (41 women), age 22–71, participated in the survey. An *ad-hoc* questionnaire was developed to collect information on sociodemographic variables, health status during the pandemic, characteristics of their AT practice, and response to the pandemic as outcome variables. The questionnaire was distributed through Google Forms in the first week of September 2020. The results show that there was an increase in the practice of autogenic therapy during the pandemic, especially among women. In addition, the majority of participants (88%) remained healthy during the pandemic. Furthermore, the results show that autogenic training is very useful for physical and psychological health and for a better understanding of others. Therefore, the practice of autogenic training is recommended to people who live moments of anxiety, are afraid of illness, or feel that they have to improve the quality of relationships with others.

Keywords: COVID-19, autogenic therapy, anxiety, autogenics, empathy

INTRODUCTION

Humanity is now facing an unprecedented crisis with medical, psychological, economic and social aspects. The COVID-19 December 2019 outbreak in Wuhan spread rapidly to all the world (Chen et al., 2020) and by March 2020 made its full impact on Spain. Exceptional measures were taken, including the confinement of all large sectors of the population (Arango, 2020; Ozamiz-Etxebarria et al., 2020b). Severe negative effects in mental health have been reported, mainly related to fear of contagion (Ammar et al., 2020b,c; Shigemura et al., 2020) and adaptation to the confinement (Qiu et al., 2020). Psychological resources have been applied to ease this psychological impact (de Rivera, 2020; Lupe et al., 2020; Ozamiz-Etxebarria et al., 2020a), including computer-assisted distance training in relaxation (Wei et al., 2020).

In a previous experimental study, we reported the efficacy of relaxation techniques, including autogenic training, on easing COVID-19-related anxiety on young university students in the Basque Country (Ozamiz-Etxebarria et al., 2020a). Autogenic training (AT), created by Johannes Heinrich Schultz (1932) as a method of “concentrative self-relaxation,” promptly became a standard tool in European psychosomatic medicine and clinical psychology (Hoffmann, 2017). Sustained regular practice decreases stress reactivity (Henry et al., 1991), enhances emotional stability (Carruthers, 1979), reduces trait anxiety, and increases the sense of personal control (Farnè and Jimenez-Muñoz, 2000). Initially, regarded as a variant of auto-hypnosis, autogenics is now more appropriately considered a non-Buddhist meditation/mindfulness method, able to facilitate personal development and to increase resilience to stress and sturdiness in emotional crisis (Carruthers, 1979; de Rivera, 2018).

The present survey focuses on the beneficial effects of the practice of AT during the pandemic in 75 usual practitioners of autogenic training (hereafter AT) living in Spain. Specifically, we inquired about their health status during the pandemic, their COVID-19-related anxiety, and how AT practice is helping them to maintain their physical, psychological, and relational health.

We anticipated that demographic variables, such as age, gender, and geographical location (see Section “Participants”), may have a relation with our outcome variables. Other variables that we anticipated having an effect on our outcome variables are the frequency of AT practice and the AT seniority (number of months practicing AT). The outcome variables are COVID-19-related anxiety and the evaluation by the participants of the degree in which AT practice helps in their psychological, physical, and relational health.

MATERIALS AND METHODS

Participants

The participants were 75 practitioners of AT (58.7% from Madrid; 41.3% from other regions of Spain); 41 were women (54.7%), and 34 were men (45.3%). Their mean age was 50.92 years ($SD = 11.19$) with a range of 22 to 71 years. As for their professions, 33 (44%) of them were health professionals (medical doctors 18.7%, psychologists 17.3%, and other healthcare

workers 8%), 27(36%) were other professionals, 12(16%) were clerical and services workers, and 3(4%) were retired. The inclusion criterion was that they were trained in AT and practiced the method regularly. The exclusion criterion was that they were not of legal age.

Measures and Instruments

An *ad-hoc* questionnaire was developed to collect information on sociodemographic variables, characteristics of AT practice, health status, and participants’ opinion on the benefits of their AT practice.

The variables studied are described below:

The sociodemographic variables studied were gender, age, place of residence, and profession.

The characteristics of AT practice were the frequency of practice at normal times, the frequency during the pandemic, and the length of time they had been practicing the AT method.

Specifically, the questions were as follows:

- For how long have you been practicing autogenics? Please indicate years, months and days.
- How many times a week do you usually practice autogenic training?
- Since the pandemic began to spread, how many times a week have you practiced autogenic training?

The health status variable asked was whether they had become ill since the pandemic began, and if so, from what illness.

The specific question was as follows:

- Have you become ill since the pandemic began? If so, please indicate the illness.

The questions on the benefits of AT practice were (responses were graduated on a Likert scale from 0 to 10):

- Do you think autogenic training has helped you to stay psychologically healthy?
- Do you think autogenic training has helped you to stay physically healthy?
- Do you think autogenic training has helped you to understand others better?

Finally, *the question on anxiety created by the COVID-19 pandemic* was as follows:

- Are you anxious about being infected by the COVID-19 virus?

Procedure

One hundred graduates from the Madrid International Committee of Autogenic Therapy (ICAT) Centre were contacted by email through the ICAT databases and asked to complete an online questionnaire on their demographic data, details of their autogenic practice, and their response to the pandemic. The study had the approval of the Ethics Committee for Research Related to Human Beings of the University of the Basque Country. All subjects participated on a voluntary basis, received information about the procedure of the investigation, and gave their informed consent. Therefore, the procedure complied with the requirements of the Helsinki Declaration of the World Medical Association.

The *ad-hoc* questionnaire was distributed through Google Forms in the first week of September 2020. After analyzing the database in Microsoft Excel,¹ 25 questionnaires showing a pattern of non-response in certain items were removed from the total sample. The study fulfilled all the provisions of Law 15/1999 on the Protection of Personal Data and, in addition, participants gave their informed consent on a voluntary basis before completing the questionnaire.

Data Analysis

The data extracted from the Google Forms questionnaire were imported into the IBM SPSS v.26 (SPSS Inc., Chicago, IL) for Windows for descriptive and inferential analyses of the sample.

Through the Kolmogorov–Smirnov test, we found that all variables, except age, followed a non-normal distribution, so we performed non-parametric tests in the inferential analysis. We used the non-parametric Mann–Whitney *U* test to compare the differences in the AT variables and in the outcome variables by gender, profession, and region of residency. We carried out the Spearman's correlation coefficient to ascertain the correlation between age and AT variables and outcome variables, and also to ascertain correlations between the different AT variables and outcome variables. We used the Wilcoxon signed-rank test to compare the usual frequency of AT practice and the practice during the pandemic.

RESULTS

AT Variables

The usual frequency of AT practice (number of exercises per week) for the overall sample is 8.64 (*SD* = 6.48, range from 1 to 21) and by gender is 7.27 (*SD* = 5.81) for women and 10.29 (*SD* = 6.92) for men.

The frequency of AT practice increased during the pandemic to 10.01 (*SD* = 7.04, range from 1 to 31) exercises per week for the overall sample. By gender, women practice increased to 8.66 (*SD* = 6.84) exercises per week and men to 11.65 (*SD* = 7) exercises per week. The increase in AT frequency of practice during the pandemic is significant in the general sample ($Z = -3.05$, $p < 0.002$).

AT seniority has a median of 18 months and a mean of 63 months (*SD* = 115.20, range from 2.5 months to 480 months). There are significant differences by profession, with healthcare workers having greater AT seniority than other professions ($M = 112.93$, $SD = 152.10$ vs. $M = 23.75$, $SD = 48.11$; $U = 265.00$, $p < 0.001$). There is also a positive correlation between age and AT seniority, $r = 0.313$ ($p < 0.006$).

Health Status

Nine persons of the sample became ill during the pandemic (12%) and 66 remained in good health (88%). Of those who became ill, four were infected by the COVID-19 virus (5.3%), three reported psychological disturbances (4%), and two other medical disorders (2.7%; **Table 1**).

Those infected by the COVID-19 virus were three women and one man; their mean age was 47 years with a range of 37 to 60 years. One of them was asymptomatic, and the other three had a mild course at home with no need for hospitalization. All of them were from Madrid, the region of Spain most affected by the COVID-19 virus, with an infection rate of 13.3% at the time of the study, 7.9% being the general prevalence in Spain (Metroscofia, 2020).

All the participants maintained or increased their AT practice during the pandemic, although statistical significance for the increase of practice was reached only in the group of those who remained healthy (increase $M = 1.23$, $SD = 4.42$; $Z = -2.630$; $p < 0.009$).

Outcomes: AT Helps Psychologically, Physically, and in Understanding Others, and COVID-19-Related Anxiety

Table 2 reflects the assessment of AT benefits (psychological, physical, and relational) and COVID-19-related anxiety by health status. As for the participants' evaluation of the degree AT practice has helped them to keep psychologically healthy, on a Likert scale from 0 to 10, the ratings for the general sample were 8.03; (*SD* = 1.81). By gender, women rated 8.36 (*SD* = 1.31) and men, 7.52 (*SD* = 2.33); by profession, healthcare workers 8.04 (*SD* = 1.61) and other professions 8.03 (*SD* = 1.98); and by site of residence, those living in Madrid rated 7.69 (*SD* = 1.66) and those from other regions of Spain 8.44 (*SD* = 1.93).

As to what extent AT practice has helped them to stay physically healthy, the overall sample rated 7.39 (*SD* = 1.81). By gender, women, 7.53 (*SD* = 1.61) and men, 7.20 (*SD* = 2.08); by profession, healthcare workers 7.24 (*SD* = 2.19) and other professions 7.50 (*SD* = 1.52); and by site of residence, those from Madrid rated 7.00 (*SD* = 1.81) and those from other regions 7.89 (*SD* = 1.72).

As to what extent AT practice has helped them to better understand others, the overall ratings are 7.57 (*SD* = 2.17). By gender, women rated 7.68 (*SD* = 2.07) and men 7.46 (*SD* = 2.30); by profession, healthcare workers 7.77 (*SD* = 1.86) and other professionals 7.40 (*SD* = 2.43); and by site of residence, those from Madrid rated 7.41 (*SD* = 1.88) and those from other regions 7.79 (*SD* = 2.54).

There are significant differences only to the degree in which AT helps psychologically by site of residence, which is slightly lower in Madrid than in the other regions of Spain (Madrid $n = 44$, $M = 8$, $SD = 1.52$; other regions of Spain, $n = 31$, $M = 8.52$, $SD = 1.81$; $U = 302.00$, $p < 0.034$).

As for the COVID-19-related anxiety, in a rating from 0 to 10, the total sample mean was 4.38 (*SD* = 2.68). By gender, women rated 3.95 (*SD* = 2.65) and men 4.88 (*SD* = 2.66); by profession, healthcare workers, 4.27 (*SD* = 2.44) and other professions 4.46 (*SD* = 2.89); and by site of residence, Madrid 4.24 (*SD* = 2.67) and other regions 4.55 (*SD* = 2.72). There is a non-significant and negative correlation ($r = -0.041$) between age- and COVID-19-related anxiety ($p < 0.732$).

As shown in **Table 3**, there are significant positive correlations between the usual frequency of AT practice and the evaluation

¹<https://products.office.com/>

TABLE 1 | AT patterns of practice and AT seniority by health status.

Health status	<i>n</i>	<i>Fr</i>	Usual practice	Pandemic practice	AT seniority
Healthy	66	88	8.45 (6.18)	9.69 (6.92)	67.27 (121.74)
COVID-19	4	5.3	8.50 (8.58)	9.75 (7.54)	54.00 (39.80)
Psychological	3	4	4.67 (4.73)	10.33 (9.05)	20.00 (6.93)
Medical disorders	2	2.7	21.00 (0.00)	21.00 (0.00)	4.35 (0.92)

TABLE 2 | Health status, evaluation of AT benefits (psychological, physical, and relational) and COVID-19-related anxiety.

Health status	AT helps psychologically	AT helps physically	AT helps understand	COVID-19 anxiety
Healthy	8.02 (1.80)	7.34 (1.80)	7.38 (2.22)	4.25 (2.64)
COVID-19	8.25 (1.36)	7.50 (1.73)	8.50 (1.00)	3.50 (2.52)
Psychological disturbances	8.00 (3.46)	8.33 (2.89)	8.33 (2.89)	7.33 (2.52)
Medical disorders	8.00 (0.00)	7.00 (0.00)	9.00 (1.41)	7.00 (0.00)

TABLE 3 | Spearman's correlation coefficient between AT variables and outcomes.

S. No.		1	2	3	4	5	6
1.	Usual frequency						
2.	Pandemic frequency	0.852**	–				
3.	AT seniority	–0.098	0.148	–			
4.	AT psychologically	0.321*	0.209	–0.031	–		
5.	AT physically	0.266*	0.188	–0.028	0.822**	–	
6.	AT empathy	0.433**	0.291*	0.050	0.818**	0.821**	–
7.	Afraid of COVID-19	0.042	–0.037	–0.013	–0.021	–0.003	–0.162

n = 75. **p* < 0.05; ***p* < 0.001.

of the degree in which AT helps psychologically ($r = 0.321$), physically ($r = 0.266$) and in understanding others ($r = 0.433$). Regarding the frequency of AT practice during the pandemic, there are significant positive correlations only with the evaluation of the degree in which AT helps understand others better ($r = 0.291$). Therefore, the more frequent the usual AT practice, the higher the evaluation of its psychological, physical, and relational benefits, whereas the frequency of AT practice during the pandemic only correlates with the ability to understand others.

DISCUSSION

The descriptive data of the study show a similar proportion of women (54.7%) to men (45.3%). Nearly half of them were healthcare professionals, and almost half of the sample resided in the city of Madrid. The usual frequency of AT practice, measured by the number of AT exercises per week, is 8.64 times/week on average. The recommended frequency ranges from 7 to 21 times per week, being somewhat higher during the learning period of the technique (3 times/day), whereas experienced trainees tend to practice once a day (7 times/week). As for gender differences, men tend to practice AT more times per week than women, both during normal times and during the pandemic. In addition, both women and men increased their AT practice during the pandemic, women to a greater extent.

The increase of practice during the pandemic may reflect a response to higher levels of stress and anxiety, which is concordant with the findings of Ozamiz-Etxebarria et al. (2020a) on the effects of AT on easing COVID-related anxiety in an experimental study with university students. This increase is more significant in women probably because they tend to experience higher anxiety during the pandemic (Lai et al., 2020; Liu et al., 2020).

The positive correlation between age and AT seniority may seem obvious, as older people have had more years to practice than younger ones; but it may also indicate that AT practice, once initiated, tends to become a life-long habit. The somewhat counterintuitive negative correlation found between COVID-related anxiety and age corroborates other studies showing that older people present less anxiety than younger ones during the current pandemic (Picaza Gorrochategi et al., 2020).

In terms of professions, the most significant finding is that health professionals have been practicing longer than other professionals. This is probably because health professionals have had easier access to AT and therefore may have started practicing earlier than others.

Fear of contagion has been one of the most frequent psychological reactions in the population during the current pandemic. However, the fear levels are low in our overall sample, as on a scale from 1 to 10 women rated an average of 4.20 and men an average of 5. The tendency of men to show more COVID-19-related anxiety than women is in contradistinction to a study in Cuba reporting significantly

greater fear of COVID-19 in women (Broche-Pérez et al., 2020) and to several other studies showing that women have had more anxiety during the pandemic (Lai et al., 2020; Liu et al., 2020). The lower anxiety scores in women in our sample may be explained by their greater increase of AT practice during the pandemic. These low levels of COVID-related anxiety in our sample may be related to the practice of autogenic training, and effect already shown in an experimental study by Ozamiz-Etxebarria et al. (2020a).

It is interesting that most participants (88%) remained healthy during the pandemic, and only 5.3%, all from the Madrid region, became infected by the COVID-19 virus. Taking into account that the calculated prevalence of infection at the time of the study was 13.3% for the Madrid region (Metroscopia, 2020), the results of the present sample are quite optimistic and may suggest that AT may have a protective effect against virus infection.

We found that participants who remained healthy increased significantly their AT practice during the pandemic, which may indicate that increased practice has both physical and psychological health benefits.

Participants who were infected by the COVID-19 virus had the least COVID-related anxiety whereas those who became ill for other causes had the greatest. This may seem obvious, as those who had already experienced the COVID-19 infection may have felt relieved by the mild course of the illness and also protected against repeated infection, whereas those ill for other causes may have increased fear of their condition being complicated by COVID-19.

Another positive fact of the present study, which points to the benefits of AT, is that the people who have remained healthy throughout the pandemic, without contracting any type of disease, are precisely those who have been practicing AT for more years, with an AT seniority about twice those who became ill. This finding confirms previous data showing that, besides the immediate effects of the AT exercises on neurovegetative function, regular practice over a number of years permanently increases the body's homeostatic functions and thus increases resilience to illness (Luthe and Schultz, 1970a). More recent research has shown that AT improves the immune function (Minowa and Koitabashi, 2014).

According to the participants, AT has a positive effect on their psychological and physical health and in their ability to understand others. This perception tends to be somewhat higher in women, although it does not reach statistical significance. Nor are there any statistically significant differences when comparing the psychological, physical, and relational effects in terms of professions. This leaves the question open for further studies with a larger number of participants. In terms of site of residence, it seems that people living in other regions of Spain perceive that AT is helping them more than those living in Madrid. This occurs at both psychological and physical levels, as well as in understanding others. Madrid is one of the hardest hit cities, not only by COVID-19 but also by constant changes in confinement regulations (Mucientes, 2020), which may create discouragement among its population. However, although the difference is not significant, it seems that they

also tend to have less anxiety about COVID-19. Perhaps, the fact of observing so much contagion in the city diminishes the fear because the virus is better known to the people of Madrid.

Participants value AT highly as helpful in maintaining psychological health. The degree of positive evaluation of the benefits of AT correlates with the usual frequency of AT practice. This is a well-known effect of AT, and achieving emotional stability is one of the main reasons for its application in clinical psychology (Luthe and Schultz, 1970b; Hoffmann, 2017). Autogenic training has also been reported to improve psychological wellbeing in chronic medical patients (Ramirez-Garcia et al., 2020).

Participants also value AT as highly helpful in maintaining physical health. As previously, this perception correlates with the usual frequency of practice and is concordant with research showing that AT practice increases the body's homeostatic functions and the resilience to illness (Luthe and Schultz, 1970a). Furthermore, a meta-analysis of clinical outcome studies has shown positive effects of AT for tension headache, migraine, mild-to-moderate essential hypertension, coronary heart disease, bronchial asthma, unspecified somatoform pain disorder, Raynaud's disease, anxiety disorders, dysthymia, mild-to-moderate depression, and functional sleep disorders (Stetter and Kupper, 2002).

In terms of relating better to others, the average scores are also high, showing that AT may help to overcome the relationship difficulties associated with confinement (Brooks et al., 2020). The practice of AT is known to increase empathy and other positive personality traits, an effect called "the third autogenic switch" (de Rivera, 2018; Ross, 2020). As expected, this third autogenic switch is correlated in our sample with the frequency of practice, both in usual times and during the pandemic.

Social relationships have also been damaged during this pandemic, as strong measures of social distancing and confinement have totally changed the way people relate to each other. Isolation and loneliness have been the major relational problems of this pandemic (Brooks et al., 2020; Smith and Lim, 2020). Therefore, the perception that AT helps to understand others better is a further argument in favor of its practice.

AT seniority does not significantly influence the evaluations of the effects of AT on physical, psychological, and relational health, which may indicate that people who have been practicing AT for a short time are as aware of its benefits as those who have been practicing over longer periods. In other words, it seems that the positive effects of autogenic training are noticeable from the very beginning of its practice.

The strength of this research is that it is the first study on the benefits of autogenic training in coping with the adverse psychological effects of the pandemic. The two main limitations of the study are the small size of the sample, which may prevent several tendencies to reach statistical significance, and the failure of taking into account in the selection criteria the health status of the participants, so to exclude its influence in our results. These aspects should be taken into account in the future studies.

CONCLUSION

Practitioners of autogenic training consider this practice highly helpful to their physical and psychological health and for the better understanding of others. These three aspects are very important during the COVID-19 pandemic. Social relations have deteriorated due to social isolation (Ammar et al., 2020a; Hickie, 2020), and AT is useful in facilitating empathy. Psychological health has suffered during the pandemic, as shown in different studies (Ozamiz-Etxebarria et al., 2020b), and the physical dimension is obvious in times when the risk and fear of getting sick, especially of COVID-19, have increased significantly (Ornell et al., 2020). Therefore, we recommend the practice of autogenic training to people who are living moments of anxiety, are afraid of the disease or feel they have lost the quality of relationships with others.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

REFERENCES

- Ammar, A., Chtourou, H., Boukhris, O., Trabelsi, K., Masmoudi, L., Brach, M., et al. (2020a). COVID-19 home confinement negatively impacts social participation and life satisfaction: a worldwide multicenter study. *Int. J. Environ. Res. Public Health* 17:6237. doi: 10.3390/ijerph17176237
- Ammar, A., Mueller, P., Trabelsi, K., Chtourou, H., Boukhris, O., Masmoudi, L., et al. (2020b). Psychological consequences of COVID-19 home confinement: The ECLB-COVID19 multicenter study. *PLoS One* 15:e0240204. doi: 10.1371/journal.pone.0240204
- Ammar, A., Trabelsi, K., Brach, M., Chtourou, H., Boukhris, O., Masmoudi, L., et al. (2020c). Effects of home confinement on mental health and lifestyle behaviours during the COVID-19 outbreak: insights from the ECLB-COVID19 multicenter study. *Biol. Sport* 38, 9–21. doi: 10.5114/biolSport.2020.96857
- Arango, C. (2020). Lessons learned from the coronavirus health crisis in Madrid, Spain: how COVID-19 has changed our lives in the last 2 weeks. *Biol. Psychiatry* 88, e33–e34. doi: 10.1016/j.biopsych.2020.04.003
- Broche-Pérez, Y., Fernández-Fleites, Z., Jiménez-Puig, E., Fernández-Castillo, E., and Rodríguez-Martin, B. C. (2020). Gender and fear of COVID-19 in a Cuban population sample. *Int. J. Ment. Health Addict.* 1–9. doi: 10.1007/s11469-020-00343-8 [Epub ahead of print]
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8
- Carruthers, M. (1979). Autogenic training. *J. Psychosom. Res.* 23, 437–440. doi: 10.1016/0022-3999(79)90059-X
- Chen, Q., Liang, M., Li, Y., Guo, J., Fei, D., Wang, L., et al. (2020). Mental health care for medical staff in China during the COVID-19 outbreak. *Lancet Psychiatry* 7, e15–e16. doi: 10.1016/S2215-0366(20)30078-X
- de Rivera, L. (2018). *Autogenics 3.0 – The New Way to Mindfulness and Meditation*. Charleston: Createspace.
- de Rivera, L. (2020). Autogenics and integrative sequential psychotherapy. A tool to overcome emotional crises. Applications in the COVID-19 pandemic. *Psicosom. Psiquiatr.* 13, 60–67.
- Farné, M. A., and Jimenez-Muñoz, N. (2000). Personality changes induced by autogenic training practice. *Stress Med.* 16, 263–268. doi: 10.1002/1099-1700(200007)16:4<263::AID-SMI860>3.0.CO;2-G

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee for Research Involving Human Subjects. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LR, LR-M, and NO-E were involved in the conceptualization of the project and in the acquisition and analysis of the data. MD-S was involved in the interpretation of the data. All authors were involved in the drafting and revising of the work for intellectual content, provided approval for submission of the contents for publication, and agreed to be accountable for the accuracy and integrity of the project.

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- Henry, M., de Rivera, L., de Las Cuevas, C., González, L., Gracia, R., Abreu, J., et al. (1991). Reducción de la reactividad neurovegetativa ante el estrés en asmáticos crónicos con terapia autógena. *Psiquis* 12, 255–261.
- Hickie, I. (2020). As 'lockdown fatigue' sets in, the toll on mental health will require an urgent response. *The Conversation*. Available at: <https://theconversation.com/as-lockdown-fatigue-sets-in-the-toll-on-mental-health-will-require-an-urgent-response-143817> (Accessed May 5, 2021).
- Hoffmann, B. (2017). *Handbook Autogenes Training*. Frankfurt: Deutscher Taschenbuch Verlag – dtv.
- Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., et al. (2020). Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw. Open* 3:e203976. doi: 10.1001/jamanetworkopen.2020.3976
- Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter. *Psychiatry Res.* 287:112921. doi: 10.1016/j.psychres.2020.112921
- Lupe, S. E., Keefer, L., and Szigethy, E. (2020). Gaining resilience and reducing stress in the age of COVID-19. *Curr. Opin. Gastroenterol.* 36, 295–303. doi: 10.1097/MOG.0000000000000646
- Luthe, W., and Schultz, J. H. (1970a). *Autogenic Therapy. Vol II. Medical Applications*. New York: Grune & Stratton.
- Luthe, W., and Schultz, J. H. (1970b). *Autogenic Therapy. Vol III. Applications in Psychotherapy*. New York: Grune & Stratton.
- Metroscopia (2020). Prevalencia declarada de la COVID-19 en España / 4ª Oleada. Available at: <https://sway.office.com/eOBPKrA6ogzBs69h> (Accessed May 5, 2021).
- Minowa, C., and Koitabashi, K. (2014). The effect of autogenic training on salivary immunoglobulin A in surgical patients with breast cancer: a randomized pilot trial. *Complement. Ther. Clin. Pract.* 20, 193–196. doi: 10.1016/j.ctcp.2014.07.001
- Mucientes, E. (2020). Madrid, pendiente de si Ayuso y Sánchez llegan a un acuerdo antes del Consejo de Ministros. *El mundo*, September. Available at: <https://www.elmundo.es/espana/2020/10/09/5f7f9b71fc6c83bf318b4690.html> (Accessed May 5, 2021).
- Ornell, E., Schuch, J. B., Sordi, A. O., and Kessler, F. (2020). "Pandemic fear" and COVID-19: mental health burden and strategies. *Braz. J. Psychiatry* 42, 232–235. doi: 10.1590/1516-4446-2020-0008
- Ozamiz-Etxebarria, N., Dosal Santamaría, M., Eiguren Munitis, A., and Picaza Gorrotxategi, M. (2020a). Reduction of COVID-19 anxiety levels through

- relaxation techniques: a study carried out in northern Spain on a sample of young university students. *Front. Psychol.* 11:2038. doi: 10.3389/fpsyg.2020.02038
- Ozamiz-Etxebarria, N., Dosil-Santamaria, M., Picaza-Gorrochategui, M., and Idoiaga-Mondragon, N. (2020b). Níveis de estresse, ansiedade e depressão na primeira fase do surto de COVID-19 em uma amostra no norte da Espanha. *Cad Saúde Pública* 36:e00054020. doi: 10.1590/0102-311x00054020
- Picaza Gorrochategui, M., Eiguren Munitis, A., Dosil Santamaria, M., and Ozamiz Etxebarria, N. (2020). Stress, anxiety, and depression in people aged over 60 in the COVID-19 outbreak in a sample collected in northern Spain. *Am. J. Geriatr. Psychiatry* 28, 993–998. doi: 10.1016/j.jagp.2020.05.022
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., and Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen. Psychiatry* 33:e100213. doi: 10.1136/gpsych-2020-100213
- Ramirez-Garcia, M. P., Leclerc-Loiselle, J., Genest, C., Lussier, R., and Dehghan, G. (2020). Effectiveness of autogenic training on psychological well-being and quality of life in adults living with chronic physical health problems: a protocol for a systematic review of RCT. *Syst. Rev.* 9:74. doi: 10.1186/s13643-020-01336-3
- Ross, I. R. F. (2020). Autogenic switches and well-being – a discussion document. British Autogenic Society Newsletter No 19: Winter 2020.
- Schultz, J. H. (1932). *Das Autogene Training: Konzentrierte Selbstentspannung*. Stuttgart: Thieme.
- Shigemura, J., Ursano, R. J., Morganstein, J. C., Kurosawa, M., and Benedek, D. M. (2020). Public responses to the novel 2019 coronavirus (2019–nCoV) in Japan: Mental health consequences and target populations. *Psychiatry Clin. Neurosci.* 74, 281–282. doi: 10.1111/pcn.12988
- Smith, B. J., and Lim, M. H. (2020). How the COVID-19 pandemic is focusing attention on loneliness and social isolation. *Public Health Res. Pract.* 30:3022008. doi: 10.17061/phrp3022008
- Stetter, F., and Kupper, S. (2002). Autogenic training: a meta-analysis of clinical outcome studies. *Appl. Psychophysiol. Biofeedback* 27, 45–98. doi: 10.1023/A:1014576505223
- Wei, N., Huang, B. C., Lu, S. J., Hu, J. B., Zhou, X. Y., Hu, C. C., et al. (2020). Efficacy of internet-based integrated intervention on depression and anxiety symptoms in patients with COVID-19. *J. Zhejiang Univ. Sci.* 21, 400–404. doi: 10.1631/jzus.B2010013
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The Relationship Between Perceived Stress and Subjective Cognitive Decline During the COVID-19 Epidemic

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During the outbreak of the COVID-19 epidemic, fear of disease and its consequences, recommended lifestyle changes, and severe restrictions set by governments acted as stressors and affected people's mood, emotions, mental health, and wellbeing. Many studies conducted during this crisis focused on affective and physiological responses to stress, but few studies examined how the crisis affected cognition. The present cross-sectional study examined the relationship between physiological, affective, and cognitive responses to the epidemic. In an online survey conducted at the height of the first wave of the epidemic in Slovenia (April 15–25, 2020), 830 Slovenian residents aged 18–85 years reported the effects of stressors (confinement, problems at home, problems at work, lack of necessities, and increased workload), experienced emotions, generalized anxiety, perceived stress, changes in health, fatigue and sleep quality, and perceived changes in cognition during the epidemic. Risk factors for stress (neuroticism, vulnerability, general health, gender, and age) were also recorded. We hypothesized that stressors and stress risk factors will be related to subjective cognitive decline, with negative emotions, generalized anxiety, perceived stress, and physical symptoms acting as mediator variables. On average, the results showed a mild subjective cognitive decline during the epidemic. In structural equation modeling, 34% of its variance was predicted by the mediator variables, with negative emotions and physical symptoms having the largest contribution. Stress risk factors were predictably related to the four mediator variables. Among the stressors, confinement showed the strongest effect on the four mediator variables, implying the importance of thoughtful communication about necessary restrictive measures during emergency circumstances. The results of this study indicate that the possibility of altered cognitive function should be considered when planning work and study activities during the epidemic.

Keywords: COVID-19, SARS-CoV-2, stress, emotions, cognitive complaints, physical health, cognitively normal adults

INTRODUCTION

On March 11, 2020, the World Health Organization declared a COVID-19 pandemic (Ghebreyesus, 2020). Slovenia declared the epidemic on March 12, 2020 (Government of the Republic of Slovenia, 2020a). Due to the sudden nature of the COVID-19 outbreak and high infectiousness of the SARS-CoV-2 virus, the Slovenian Government implemented several restrictions. In addition to the introduction of the minimum physical distance of 1.5 m and the mandatory use of face masks, freedom of movement was restricted to small municipalities, people were expected to self-isolate in their homes, most economic activities were stopped, and public life was closed. Public services such as public transport and health services were restricted. Shops were closed, except for grocery stores. Educational institutions were closed and switched to online teaching. According to Eurofound (2020), in April and May 2020, 10% of people reported that they worked from home every day or several times a week before the epidemic, and 23% reported that they started working from home as a result of the situation, with 17% of residents reporting that their working hours increased and 46% reporting that they decreased. The media covered the crisis extensively, and the amount of information about COVID-19 and the ever-changing measures to limit the outbreak was overwhelming. In retrospect, it could be assumed that Slovenians quickly adapted to the emergency measures and followed strict restrictions and recommended lifestyle changes, making Slovenia the first European country to announce the end of the first wave of the epidemic on May 15, 2020 (Government of the Republic of Slovenia, 2020b). However, the implemented restrictions affected people's behavior and psychological wellbeing (Lep and Hacin Beyazoglu, 2020).

Stress During the COVID-19 Epidemic

The course of the COVID-19 pandemic as a global, prolonged health crisis was unpredictable and beyond control of individuals. It caused stress to many people, and the measures taken to restrict the spread of the virus had many negative effects. A plethora of studies conducted around the world, including in Slovenia (Lep and Hacin Beyazoglu, 2020), showed that the COVID-19 crisis affected people's mood and emotions (Xiao et al., 2020), leading to decreased subjective wellbeing (Möhrling et al., 2020; Ammar et al., 2021b; Paredes et al., 2021), sleep disturbances (Gualano et al., 2020; Pinto et al., 2020; Saraswathi et al., 2020; Ammar et al., 2021b), and increased prevalence of psychiatric conditions, such as generalized anxiety disorder, depression, or post-traumatic stress symptoms (Fu et al., 2020; Liu et al., 2020). The confinement during the epidemic also resulted in an increase of social isolation, physical inactivity (the hours of daily-sitting) and unhealthy diet behaviors (Ammar et al., 2021b). However, only few studies examined how people's cognition changed during the COVID-19 crisis. Batty et al. (2020), in a prospective cohort study using UK Biobank data, found that a higher risk of hospitalization for COVID-19 was observed for participants with lower performance on two tests of cognitive function – verbal and numerical reasoning and reaction speed – which the authors suggested could be potential

markers of health literacy. Commenting on the consequences of the COVID-19 pandemic, Boals and Banks (2020, p. S255) suggested that increases in stress and anxiety are likely to impair cognitive functioning. They wrote that “anecdotally, in the time since the pandemic, students and colleagues have shared that they have had trouble staying focused and productive.” Our own observation was consistent with this comment – many people in our setting who worked from home reported being more tired and having more trouble multitasking. In the present study, therefore, we wanted to investigate how different stressors, i.e., different aspects of the COVID-19 crisis, such as stress related to changes in living and working conditions, affected the adult population of Slovenia. We wanted to examine the relationship between different types of stress responses, including physiological, affective, and cognitive responses. More specifically, we were interested in subjectively reported change in cognitive performance.

Physiological, Affective and Cognitive Responses to Stress

Stress affects mood and emotions, cognition, behavior, wellbeing, and health (Schneiderman et al., 2005). It activates the hypothalamic–pituitary–adrenal (HPA) axis, resulting in physiological responses such as increased cortisol secretion (Kemeny, 2003), heart rate, respiratory rate, blood pressure and muscle tension, making an organism ready for action. Affective responses to stress include negative affect (e.g., feelings of tension, panic, feeling overwhelmed, irritability, restlessness, anger, guilt, sadness, grief, and depression) or positive affect (e.g., feelings of happiness, enthusiasm, contentment, and excitement; Zhaoyang et al., 2020). Cognitive responses to stress include mental slowing, confusion, narrowing of focus, difficulty concentrating, memory impairment (forgetfulness), increased or decreased awareness of one's surroundings, general negative thinking, intrusive and repetitive thoughts and images, constant worry, difficulty making decisions, poor abstract thinking, disturbed thinking, difficulty identifying familiar objects or people, loss of orientation in time and place, and changes in learning and memory (Becker et al., 1973; Bryce, 2001; Kemeny, 2003).

The direct effect of stress on cognitive functions is not entirely clear, and research examining the effects of stress on executive functions has yielded counterintuitive results (see Shields et al., 2016). Studies found that acute and chronic psychological stress can induce structural and functional changes in the adult brain and impair memory and executive functions (Diamond, 2013; Chattarji et al., 2015; Shields et al., 2016). Executive functions encompass the higher cognitive processes that enable cognitive control, i.e., planning, thinking ahead, and goal-directed action, and include working memory (the ability to retain information in memory and update it regularly), inhibition (the ability to inhibit thoughts or prepotent responses in order to selectively attend to task-relevant information and engage in goal-directed behavior), and cognitive flexibility (the ability to flexibly switch between cognitive rules or ways of thinking; Miyake et al., 2000; Diamond, 2013). In a meta-analysis on the effects of acute stress on executive functions,

Shields et al. (2016) showed that stress impairs working memory and cognitive flexibility and that these effects are moderated by sex; stress was also found to impair cognitive inhibition but increase response inhibition, suggesting that stress contributes to a cognitive state of automatic, reactive processing and more alert executive motor control that allows a person to quickly engage with or escape from the current stressor. Qin et al. (2009) found that experimentally induced acute stress leads to deficits in working memory, increased catecholamine and cortisol levels, reduced activation of the dorsolateral prefrontal cortex, and a reallocation of neural resources away from executive function networks. Liston et al. (2009) found in undergraduates that a month-long psychosocial stress related to exams impaired attentional shifting and disrupted functional connectivity within a frontoparietal network mediating attentional shifting, although these impairments were reversible after the stress ended. In general, stress causes a focus on the here and now, resulting in impaired retrospective and prospective memory (Bourne and Yaroush, 2003). The time span from which knowledge can be easily retrieved and used in a given context shrinks as stress levels increase (Bourne and Yaroush, 2003). Functioning during stress may be adaptive in the short term, biasing processing in favor of a single salient stimulus (Liston et al., 2009) or the current stressor to allow an organism to effectively cope with the current unstable circumstances (Shields et al., 2016).

The Interconnectedness of Different Types of Responses to Stress

Emotion and cognition are deeply intertwined (Okon-Singer et al., 2015). Intense negative emotions can interfere with focusing on, encoding, and retrieving important information. Emotions that cause high arousal can divert attention to specific stimuli and affect attentional focus, working memory, learning, reasoning, problem solving, and cognitive control, especially inhibition (Harlé et al., 2013; Okon-Singer et al., 2015). Individuals with emotional disorders, such as anxiety and depression, show impaired cognitive processes (Mathews and MacLeod, 2005). Anxiety can distort attentional processing, because it narrows the range of perceived stimuli and focuses attention on the threat. It biases evaluations of stimulus valence (Yiend, 2010), as well as individual perceptions of reality (Spielberger, 1966). Conversely, cognition can also alter, activate, and inhibit emotions; effortful cognitive strategies, such as reappraising the situation in a more positive light, can be used to cope with and regulate negative emotions (Kryla-Lighthall and Mather, 2009; Cole et al., 2014; Okon-Singer et al., 2015; Tyng et al., 2017).

Complex relationships exist between stress, fatigue, sleep, self-perceived health status, and performance (De Vries et al., 2003; Taylor and Dorn, 2006; Kocalevent et al., 2011; Khanade and Sasangohar, 2017). Sleep and stress interact in a bidirectional manner. Stress causes changes in metabolism through activation of the HPA axis and increased release of glucocorticosteroids, leading to impaired sleep (Van Reeth et al., 2000). This in turn affects the regulation of HPA axis activity, which indirectly modulates arousal (Hirotsu et al., 2015). Sleep disturbances affect how we respond to emotional events during the day, and conversely,

responses to past emotional events affect sleep quality (Altena et al., 2016). Stress, anxiety, and depression are associated with fatigue and poorer subjective sleep quality (Van Reeth et al., 2000; Valerio et al., 2016; Thorsteinsson et al., 2019; Cox and Olatunji, 2020; Xiao et al., 2020). Although some studies found no association between subjective sleep quality and cognitive performance (Zavec et al., 2020), many studies report that sleep quality also affects cognition. It is associated with problems in attention, working memory, and executive functions (Scullin and Bliwise, 2015). Sleep loss and deprivation have been found to impair performance on cognitive tasks involving vigilance and attention, working and long-term memory, learning, logical reasoning, arithmetic calculations, pattern recognition, complex verbal processing, and decision making (Krueger, 1989; Alhola and Polo-Kantola, 2007). Partial sleep restriction deteriorates memory encoding and the ability to learn declarative information (Cousins et al., 2018). Following sleep deprivation, cognitive impairments are thought to be mediated through decreased alertness, attentional lapses, and slowed responses (Alhola and Polo-Kantola, 2007). Thus, cognition can be impaired by stress, fatigue, and decreased sleep quality.

Individual Differences in Stress Reactivity

Responses to the same stressor are not the same for all individuals. Stress occurs when individuals perceive that environmental demands tax or exceed their adaptive capacity (Cohen et al., 1983, 1997), so stressful experiences can be viewed as person-environment transactions, the outcome of which depends on both the stressor and the individual (Kemeny, 2003). In terms of the nature of stressors, circumstances that are perceived as uncontrollable, ambiguous, novel, and durable are more likely to activate a stress response (Kemeny, 2003; Dickerson and Kemeny, 2004). The influence of the external stimulus is mediated by the characteristics of the individual, such as primary appraisal of the stimulus as a threat vs. challenge (Kemeny, 2003), lack of confidence (Farrer et al., 2016), coping mechanisms, self-esteem and social skills (Uchino, 2009), the efficacy of coping efforts (Schneiderman et al., 2005; Pallavicini et al., 2013), social support (Cohen et al., 2000; Cohen, 2004; Qi et al., 2020) and social capital (Xiao et al., 2020), appraisal of psychosocial resources to cope with the stressor, e.g., appraisal of coping skills, personality factors, intellectual resources, financial resources, environmental resources (Kemeny, 2003), and perceived control over potentially negative events (Gallagher et al., 2014). Stress responses, including threat appraisals, negative and positive affect, and task performance, are also related to personality traits, such as neuroticism (Schneider, 2004), extraversion, and openness (Schneider et al., 2012). In addition, larger stress responses are associated with low socioeconomic status, female gender, younger age (Scott et al., 2013; Novais et al., 2017), and poorer physical wellbeing prior to the onset of the stressor (Kocalevent et al., 2011).

Subjective Cognitive Decline

Subjective cognitive complaints are everyday memory and related cognitive concerns expressed by people with or without

objective evidence of cognitive impairment and are common across all age groups (Jacob et al., 2019). Subjective cognitive decline is not only predictive of Alzheimer's disease dementia (Jessen, 2014), but is also associated with numerous other conditions, including normal aging (dos Santos et al., 2012), depression and anxiety (Hill et al., 2016), pregnancy (Crawley et al., 2008), substance use and medication (Jessen et al., 2014), and physical illness (Jacob et al., 2019). In older individuals, memory complaints without actual cognitive decline have been found to be associated with physical health problems, depressive and anxiety symptoms, higher perceived stress and lower mastery (control of potential problems in life), ineffective coping, and high neuroticism (Comijs et al., 2002; Steinberg et al., 2013). Stenfors et al. (2013) found that subjective cognitive complaints in healthy, working non-elderly adults were related to emotional exhaustion, burnout, mental fatigue, disturbed sleep, awakening problems, depressive symptoms, and poorer executive cognitive functioning. Jacob et al. (2019) found in a large nationally representative survey that subjective concentration and memory complaints were predicted by the number of stressful life events, perceived stress, depression, anxiety disorders, sleep problems, and physical health problems (multiple chronic diseases).

The Aim of This Study

Previous studies have rarely examined the effects of chronic stress on human cognitive functions because it would be difficult and unethical to experimentally manipulate such stress conditions (Shields et al., 2016). Thus, most of the evidence on the effects of stress and emotion on cognition has been obtained in short-term experimental studies, in clinical populations, or in selected samples with long-term exposure to stress, such as certain work groups (nurses and shift workers). Less is known about how prolonged collective situational uncertainty, such as that experienced by society at the time of the COVID-19 epidemic, can affect cognitive functioning and its perception. We therefore aimed to investigate whether subjective cognitive complaints during the crisis can be predicted by the physiological and affective responses to stress.

Based on the literature presented, we developed a model of subjective cognitive change during the COVID-19 epidemic, as shown in **Figure 1**. We expected that the perceived impact of stressors caused by the COVID-19 epidemic would be related to more intense physiological responses leading to physical symptoms (including fatigue, sleep disturbance, physical pain, and worsening of illness) and affective responses (including negative emotions, generalized anxiety, and perceived stress), which in turn would be related to higher levels of subjective cognitive decline associated with impaired attention, memory, and cognitive control. We also expected stress risk factors, such as neuroticism, vulnerability to stress, poorer general health, female gender, and younger age to contribute positively to physiological and affective responses to stress. In addition, we were interested in the association between subjective cognitive change and various demographic characteristics.

MATERIALS AND METHODS

Participants

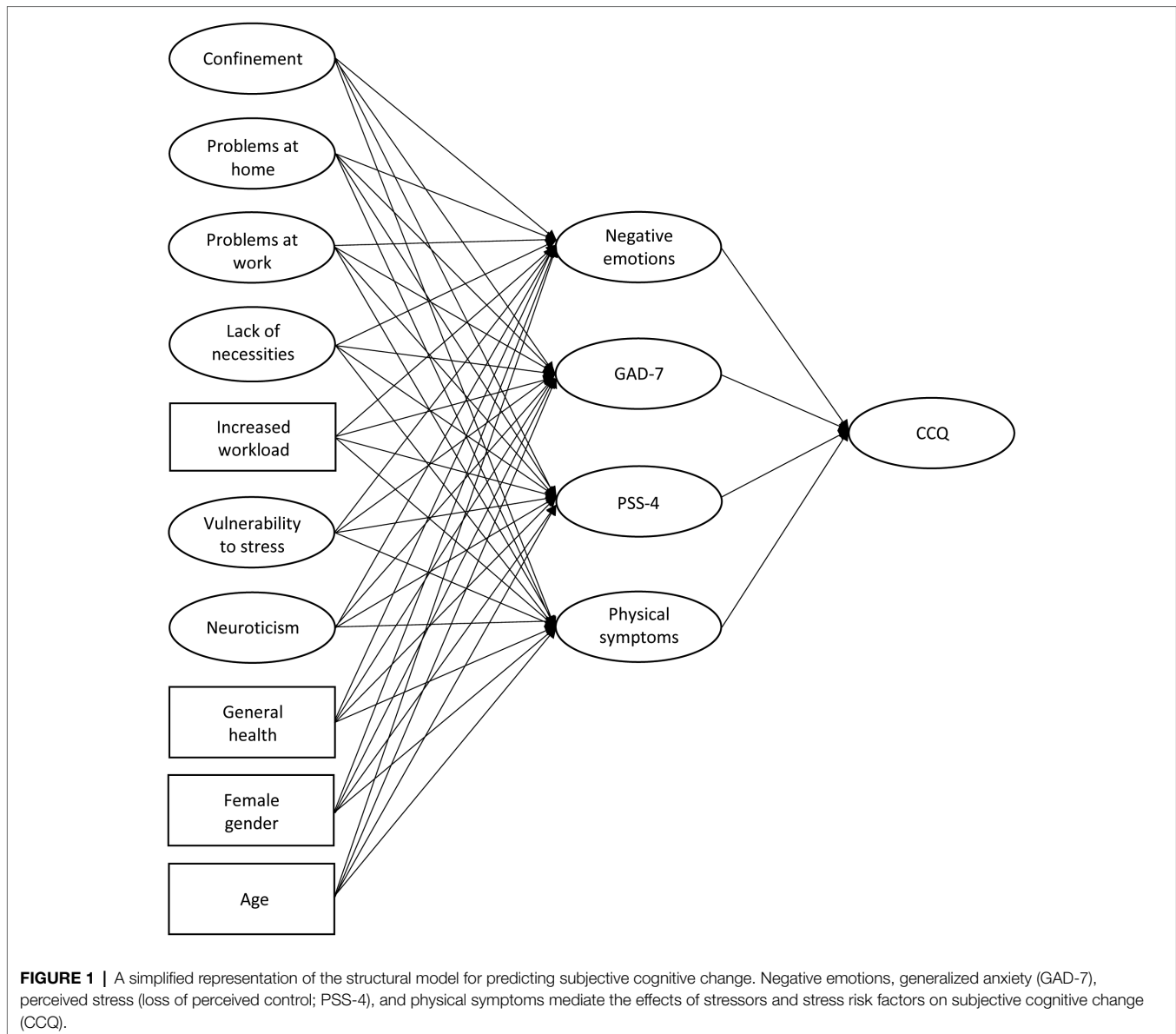
To assess perceived stress and responses to stress during the COVID-19 epidemic, we designed an online survey. The survey was open on the Slovenian online survey platform 1KA (2020) for 10 days, from April 15 to 25, 2020, at the peak of the first wave of the epidemic, when the trend of newly detected COVID-19 cases began to level off. It was accessed by 1,290 individuals. Of 1,135 who began filling it out, 1,072 (94%) completed at least part of the survey, 881 (77%) responded to the final section of the survey, and 830 participants had complete data on the variables included in the analyses. **Table 1** shows a description of the final sample by gender, age, education, marital status, and employment status. In the general population of Slovenia, the share of the same age categories as in our study was 8, 15, 18, 17, 17, 13, and 11% in the first half of 2020 (Statistical Office of the Republic of Slovenia, 2020). In our sample, the oldest age category was underrepresented, which is most likely related to the online administration of the survey.

Instruments

This research was planned and conducted in an international group of researchers from China, the United States, and Slovenia, who sought to gain insight into a wide range of experiences with the COVID-19 outbreak among participants from different countries who faced different measures to prevent the spread of the SARS-CoV-2 virus. The common core of the survey was negotiated and took into account the different contexts in the participating countries. It included a combination of self-constructed questions and questions from previously validated questionnaires. The aim was to cover many different aspects of the experiences while being manageable and time efficient for participants. In this paper, we report only the results of the study conducted in Slovenia on selected variables related to our defined research problem.

Perception of Stressors

Participants rated on a 5-point scale how much they experienced various stressors or difficulties that negatively affected their mood or emotions during the COVID-19 pandemic (1 – not at all, 2 – a little, 3 – a moderate amount, 4 – a lot, and 5 – a great deal; 'Not applicable' (N/A) was also added but later changed to 1 because if a particular factor was not relevant to the participants, it did not affect them). The first type of stressor related to the specifics of the epidemic crisis and lockdown: time spent indoors, media coverage, and restricted movement. The second type of stressor was related to difficulties at home: family relationships, intimate partner relationship, and reduced privacy. The third type of stressor included work-related problems, academic problems, and economic problems. The fourth type of stressor was lack of necessities: personal protective equipment, food, medicine, and access to a doctor. Participants also reported whether their workload had increased during the epidemic (Yes/No).



Physical Symptoms

To assess participants' physiological reactions to stress, we asked them to rate on a 5-point scale (1 – not at all, 2 – a little, 3 – a moderate amount, 4 – a lot, and 5 – a great deal; N/A was changed to 1) how much they experienced physical pain, worsening of illness, and fatigue/sleepiness during the epidemic. They also rated how tired they were and how well they slept during the COVID-19 outbreak compared to before the outbreak. These changes in fatigue and sleep quality were rated on 5-point scales (1 – much less/better, 2 – less/better, 3 – same, 4 – more/worse, and 5 – much more/worse).

Affective Responses to Stress

To assess participants' affective state and stress during the COVID-19 epidemic, we used the GAD-7 scale and self-constructed inventories of emotional states and vulnerability

indicators. A Brief Measure for Assessing Generalized Anxiety Disorder – GAD-7 (Spitzer et al., 2006) – is a clinical screening self-report measure consisting of 7 items. Participants rated on a 4-point scale how often they experienced the listed symptoms since the beginning of the epidemic (0 – never, 1 – several days, 2 – over half the days, and 3 – nearly every day). When used for clinical assessment, item responses are summed. In the study by Spitzer et al. (2006), the instrument demonstrated good reliability (Cronbach's alpha coefficient was 0.92 and test–retest intraclass correlation was 0.83), construct validity (a higher score was strongly associated with multiple domains of functional impairment and disability days), and factorial validity (the scale differentiated symptoms of generalized anxiety from those of depression).

In addition to GAD-7, participants rated how much they experienced the following emotions on a 5-point response scale

TABLE 1 | Description of nominal variables and comparison of subgroups on the Cognitive Change Questionnaire (CCQ) score.

Variable	n (%)	M (SD)	Result of the statistical test	Effect size	1 - β
Gender			$t(407.41) = -1.52, p = 0.129$	$d = -0.09$	0.34
Male	183 (22)	4.14 (0.46)			
Female	647 (78)	4.19 (0.62)			
Age (years)			$F(6, 823) = 0.83, p = 0.549,$ $MSE = 0.35$	$\eta^2 = 0.01$	0.88
18–24	86 (10)	4.25 (0.65)			
25–34	162 (20)	4.12 (0.58)			
35–44	167 (20)	4.21 (0.68)			
45–54	147 (18)	4.16 (0.65)			
55–64	123 (15)	4.14 (0.60)			
65–74	128 (15)	4.23 (0.35)			
75 and more	17 (2)	4.18 (0.25)			
Education			$t(238.09) = -0.18, p = 0.856$	$d = -0.02$	0.86
High school or less	160 (19)	4.18 (0.60)			
More than high school	669 (81)	4.18 (0.59)			
Relationship status			$t(378.26) = 0.69, p = 0.489$	$d = 0.06$	0.59
In a relationship ¹	592 (71)	4.19 (0.56)			
Not in a relationship ²	236 (28)	4.16 (0.66)			
Employment status			$F(4, 788) = 1.94, p = 0.101,$ $MSE = 0.34$	$\eta^2 = 0.01$	0.66
Student	105 (13)	4.21 (0.61)			
Working regularly/from home	354 (45)	4.15 (0.61)			
Working less than before the epidemic	96 (12)	4.07 (0.68)			
Not working ³	68 (9)	4.22 (0.61)			
Retired	170 (21)	4.25 (0.43)			
General health			$F(3, 826) = 3.82, p = 0.010,$ $MSE = 0.35$	$\eta^2 = 0.01$	0.43
Poor	9 (1)	4.20 (0.39)			
Fair	165 (20)	4.31 (0.60)			
Good	411 (50)	4.17 (0.59)			
Excellent	245 (30)	4.12 (0.59)			
Increased workload			$t(329.63) = 1.36, p = 0.174$	$d = 0.11$	0.53
Yes	207 (25)	4.23 (0.63)			
No	623 (75)	4.17 (0.58)			

¹Married or in a relationship.

²Single, divorced, separated, or widowed.

³Unemployed, on a sick leave, on a maternity leave, or on a furlough.

(1 – not at all, 2 – a little, 3 – a moderate amount, 4 – a lot, and 5 – a great deal): Anger at others, anger at self, sadness, fear, worry, annoyance, depression, distracted thinking, longing for normality, and loneliness.

Participants also completed the Perceived Stress Scale – PSS-4 (Warttig et al., 2013). PSS-4 is a 4-item version of a self-report questionnaire developed by Cohen et al. (1983) to measure how often in the past month the person felt nonspecific appraised stress and was unable to control the important things in their life (1 – never, 2 – almost never, 3 – sometimes, 4 – fairly often, and 5 – very often). The higher the score on the PSS-4, the more the respondents perceive that the demands exceed their ability to cope (Warttig et al., 2013). We therefore considered the responses on this scale to be most indicative of the loss of perceived control during the crisis. Cohen et al. (1983) found high correlations of PSS scores with depressive symptomatology and stress measures in samples of college students. Warttig et al. (2013) found acceptable psychometric properties of the PSS-4 on an English sample (Cronbach's alpha was 0.77) and low to moderate negative correlations with perceived health status, social support, and age, with women reporting higher stress than men.

Cognitive Responses to Stress

Because we were in a lockdown and faced with emergent and rapidly changing situations, we could not conduct objective cognitive tests. There were also no data available on residents' cognitive function prior to the epidemic. Therefore, we opted for self-report of the changes people observed in their everyday cognitive function. We looked for questionnaires that were general enough and did not ask about instrumental daily activities, since we targeted healthy adults. We could not find a questionnaire that could be easily applied to the situation, so we decided to develop a new instrument. The survey was long and asked about many different variables, so we wanted to keep the instrument on cognitive changes short. To capture self-perceived changes in cognition, we drew on the Working Memory Questionnaire (Vallat-Azouvi et al., 2012) and the Teenage Executive Functioning Inventory – TEXI (Thorell et al., 2020), and compiled nine questions asking about speed of information processing, short-term storage, prospective memory, attention, and executive control (see **Table 2**). We had no information about participants' previous cognitive functioning and were not interested in absolute levels of functioning, so we decided to ask participants directly about the changes they observed in their cognition during the

TABLE 2 | Item content, descriptive statistics, and standardized factor loadings from the one-factor measurement model of the CCQ.

S. No.	Item	Cognitive function	M	SD	Skew	Kurt	λ
1.	How quickly have you performed your usual activities?†	Processing speed	3.59	1.01	0.13	1.03	-0.44***
2.	How often have you had to re-read something to understand it?	Attention and working memory	4.13	0.74	-0.17	4.19	0.69***
3.	How often have you felt disturbed when something unexpectedly interrupted your activity?	Executive control (inhibition)	4.15	0.84	-0.25	3.32	0.74***
4.	How quickly do you get tired doing activities that require a lot of attention (e.g., reading, studying, following an instruction manual)?	Attention	4.23	0.92	0.12	2.03	0.76***
5.	How often have you forgotten things that should be done in the immediate future?	Prospective memory	4.11	0.87	-0.32	3.24	0.76***
6.	How much easier or harder have you found it to »multi-task«, that is, to focus your attention on several things at once (e.g., listening to the news and cooking from a recipe, working on the computer and talking to someone)?	Attention and executive control (shifting)	4.14	0.69	0.15	5.86	0.83***
7.	How much easier or harder has it been for you to plan future activities and organize things (e.g., scheduling appointments, sorting documents, paying bills, filling out forms)?	Executive control (planning and organization)	4.21	0.99	-0.19	1.58	0.60***
8.	How much easier or harder has it been for you to remember everything someone asks you to do?	Memory	4.11	0.70	0.39	5.65	0.84***
9.	How much easier or harder has it been for you to switch between tasks when doing several things at once?	Executive control (shifting)	4.15	0.73	0.45	4.08	0.83***

N = 830. Min and max were 1 [much less (often)/easier than before] and 7 [much more (often)/harder than before], respectively, for all CCQ items. Skew, skewness; Kurt, kurtosis; λ , standardized factor loadings.

†This item was scored reverse before calculating the scale score.

****p* < 0.001.

COVID-19 epidemic. They were asked to compare their current state (the state during the epidemic) with the state before the epidemic, using a 7-point scale. For items 1–5, the following scale was used: 1 – much less often, 2 – less often, 3 – a little less often, 4 – same as before, 5 – a little more often, 6 – more often, and 7 – much more often (than before). For items 6–9, the following scale was used: 1 – much easier, 2 – easier, 3 – a little easier, 4 – same as before, 5 – a little harder, 6 – harder, and 7 – much harder (than before). We will refer to these questions as the Cognitive Change Questionnaire (CCQ).

Stress Risk Factors

Participants' vulnerability to stress was assessed by their ratings on a 5-point scale (1 – not at all; 5 – a great deal) of the extent to which their sense of imbalance, self-denial, lack of resilience, vulnerability, tendency to suppress emotions, lack of family support, lack of social support, perfectionistic tendencies, poor adaptability, lack of self-confidence, and lack of coping skills played a role in their negative emotions related to the COVID-19 epidemic. Their neuroticism was rated on the same scale based on their responses to questions how much it describes them as a person to be emotionally stable and worry free. They also rated their general health (not limited to the period of the epidemic) on a 4-point scale (1 – poor, 2 – fair, 3 – good, and 4 – excellent).

The survey also asked participants about their gender, age category, employment status, relationship status, and education level.

Procedure

The Ethics Committee of the Faculty of Arts at University of Ljubljana approved the study (approval No. 184-2020). Snowball sampling was used to recruit participants. The researchers AP and VK sent invitations to their personal email contacts and posted announcements on several Facebook pages and on websites of various organizations. Participants were asked to forward the invitation to their relatives, friends, and acquaintances. Participation in the survey was voluntary. Participants received no benefits for participating in the study. They were introduced to the purpose of the survey and gave their consent to participate in the study by clicking a specific button on a survey webpage. To avoid loss of motivation and dropout from participation in the survey, answering most questions was not mandatory and could be skipped if desired. On average, participation in the survey took 15 min.

Data Analysis

Frequency distributions for each item were examined and descriptive statistics were calculated.

Structural equation modeling was used to evaluate the following theoretical model (**Figure 1**): (i) Each of the four types of responses to stress (negative emotions, generalized anxiety, perceived stress or loss of perceived control, and physical symptoms) was predicted by the perceived impact of external stressors that occurred during the epidemic (confinement, problems at home, problems at work, lack of necessities, and increased workload); (ii) each of the four types of responses to stress was also predicted by stress risk

TABLE 3 | Descriptive statistics and the reliability of the scale scores ($N = 830$).

Construct	Number of items	Scale	M	SD	Skew	Kurt	Reliability		
							α	ω	AVE
CCQ	9	1–7	4.18	0.59	−0.07	5.16	0.88	0.88	0.53
Negative emotions	10	1–5	2.27	0.70	0.51	−0.16	0.88	0.88	0.52
GAD-7	7	0–3	0.61	0.54	1.04	0.92	0.88	0.88	0.65
PSS-4	4	1–5	2.45	0.66	0.37	0.31	0.67	0.68	0.41
Vulnerability to stress	11	1–5	1.78	0.66	0.91	0.30	0.90	0.90	0.56
Neuroticism	2	1–5	2.94	0.77	0.04	−0.14	0.62	0.62	0.51
Confinement	3	1–5	3.02	0.88	−0.07	−0.49	0.60	0.61	0.39
Problems at home	3	1–5	1.84	0.86	1.13	0.90	0.65	0.65	0.49
Problems at work	3	1–5	2.00	0.90	0.81	0.01	0.60	0.63	0.45
Lack of necessities	4	1–5	1.57	0.59	1.61	3.32	0.67	0.68	0.51
Physical symptoms	5	1–5	2.13	0.46	1.23	1.85	0.69	0.69	0.53

Skew, skewness; Kurt, kurtosis; α , Cronbach's α coefficient of internal consistency; ω , McDonald's omega total; AVE, average variance extracted.

factors: vulnerability to stress, neuroticism, general health, gender, and age (age category means were analyzed); and (iii) four types of responses to stress predicted subjective cognitive change during the COVID-19 epidemic. Perceptions of stressors and stress risk factors were thus entered as predictors (exogenous variables) in the structural equation model. Physical symptoms, negative emotions, generalized anxiety, and perceived stress were treated as endogenous variables and were also considered mediators between predictors and subjective cognitive change. All observed variables (variables listed in **Supplementary Table 1**, along with gender, age, general health, and increased workload) were entered into the model simultaneously. Due to the ordinal nature of the observed variables we used the robust weighted least squares estimator (WLSMV), implemented by the *cfa* function in the R *lavaan* package (Rosseel, 2012). The following cutoff values were considered indicative of acceptable fit of the model to the data (Marsh et al., 2004): CFI and TLI > 0.90; RMSEA and SRMR < 0.08.

The reliability of the scales was calculated using the *omega* function in the R *psych* package (Revelle, 2015). Because the measurement models supported the unidimensional structure of the latent constructs under study, we calculated Cronbach's alpha coefficient as a measure of internal consistency. We also report the McDonald's omega total, which is a better choice for reliability estimation in the presence of skewed item distributions and the absence of tau-equivalence, i.e., in the case of different factor loadings (Trizano-Hermosilla and Alvarado, 2016).

Responses to items measuring a specific construct were averaged and descriptive statistics were calculated for such scale scores. Welch's *t* test and ANOVAs were used to compare the CCQ score in subsamples based on demographic variables (gender, age, education, relationship status, and employment status) and general health status.

All statistical hypotheses were tested at the significance level of 5%.

RESULTS

The Fit of the Proposed Structural Equation Model

The model tested fit the observed data closely enough, $\chi^2(1948) = 5653.79$, $p < 0.001$, CFI = 0.906, TLI = 0.912,

RMSEA = 0.048, 95% confidence interval for RMSEA = 0.046–0.049, $p(\text{RMSEA} \leq 0.05) = 0.991$, and SRMR = 0.057.

Testing the measurement models of all included constructs confirmed their one-dimensional structure. **Table 2** shows the estimated parameters in the measurement model related to the CCQ, and **Supplementary Table 1** shows the estimated parameters in the measurement models for other latent constructs. For most items, factor loadings were high and consistent with expectations. In the CCQ, all items except item 1 loaded highly on the general factor. Excluding this item would not increase the reliability of the instrument, so we decided to keep it.

The scales measuring subjective cognitive change, negative emotions, generalized anxiety, and vulnerability to stress showed good reliability (**Table 3**), with Cronbach's alpha coefficients of internal consistency exceeding the value of 0.88. The reliability of other scale scores was lower, but considering a small number of items on these scales, we concluded that their reliability was also acceptable (**Table 3**).

Responses to Stress and the Perceived Impact of Stressors

Regarding the perceived impact of stressors during the COVID-19 epidemic, participants perceived the impact of confinement on their emotions as moderate, while they reported a low impact of problems at home and at work and no to a low impact of lack of necessities (**Table 3**). A minority of participants (25%) reported experiencing increased workload during the epidemic (**Table 1**).

On average, participants were characterized by moderate levels of neuroticism and low levels of vulnerability to stress (**Table 3**). The frequency distribution of ratings of their general health is shown in **Table 1**. A large majority reported good or excellent health.

Among other constructs, **Table 3** also shows descriptive statistics for constructs related to emotional responses to stress. On average, participants reported experiencing low levels of negative emotions and infrequent to occasional perceived stress (loss of perceived control). They rarely felt anxious during the epidemic. Summing responses to GAD-7 items yielded an average total score of 4.28 points ($SD = 3.81$) on the 0–21 scale.

A large percentage of participants scored 0 on GAD-7. For 76 (9%) of participants, the scale sum was above 10, which is considered the cutoff point for identifying moderate generalized anxiety. Thus, we conclude that our sample generally exhibited only mildly negative emotions at the time of our study. In terms of physical responses to stress, participants generally reported experiencing fatigue and sleepiness to a low degree, no (or only mild) physical pain and worsening of illness, and a slight increase in fatigue and decrease in sleep quality compared to pre-epidemic times (see **Supplementary Table 1**, part Physical Symptoms).

On average, participants reported mildly impaired cognitive function during the COVID-19 lockdown (**Table 3**). During the epidemic, they were slightly slower in performing their usual activities than before the epidemic, and they noticed slight negative changes in their speed of information processing, attention, memory, and executive control (**Table 2**). The mean CCQ score (4.18) was statistically significantly larger than 4 (the response indicating no change), $t(829) = 8.90, p < 0.001, d = 0.31$, 95% confidence interval for $d = [0.17, 0.45]$, $1 - \beta = 1.00$.

No statistically significant differences were found in subjective cognitive change by gender, age, education, relationship status, and employment status (**Table 1**).

Predictors of Stress Responses and Subjective Cognitive Change

Supplementary Table 2 shows the correlations between different constructs used in the structural model for predicting physical symptoms and emotional responses to stress. **Table 4** shows the standardized regression coefficients in the structural model. Among the COVID-19 crisis stressors, confinement showed the largest effect on all four predicted constructs (negative emotions, generalized anxiety, perceived stress, and physical symptoms). Perceived increased workload contributed to more intense physical symptoms. Problems at home and at work and a lack of necessities did not appear to contribute to the emotional and physiological responses to stress. Risk factors for stress showed an expected contribution to stress responses. Stress vulnerability, poor

general health, female gender, and younger age contributed to all four types of stress responses, while neuroticism contributed only to emotional responses to stress but not to physical responses.

In the model studied, the four types of stress reactions predicted subjective cognitive change and were able to explain 34% of variance in the CCQ score. The contributions of negative emotions ($b = 0.14, SE_b = 0.05, z = 2.65, p = 0.004, \beta = 0.32$) and physical symptoms ($b = 0.40, SE_b = 0.05, z = 8.27, p < 0.001, \beta = 0.44$) were statistically significant, whereas the contributions of generalized anxiety ($b = -0.05, SE_b = 0.06, z = -0.78, p = 0.434, \beta = -0.07$) and perceived stress in terms of loss of perceived control ($b = -0.05, SE_b = 0.05, z = -0.98, p = 0.327, \beta = -0.07$) did not reach statistical significance.

DISCUSSION

Our model of subjective cognitive change during the COVID-19 epidemic showed acceptable fit to the data collected. This suggests that the COVID-19 represented a stressful situation that elicited similar responses to those in other types of stressful situations. Confinement (including media coverage and worries about the latest news and other issues) and increased workload during the COVID-19 crisis – potentiated by vulnerability to stress, neuroticism, and poor general health – led to affective, physiological, and cognitive responses that resulted in subjective cognitive decline.

A very small, but statistically significant subjective cognitive decline was reported on average by our participants. Boals and Banks (2012) suggested that perceived stress during the COVID-19 crisis could lead to intrusive thoughts that compete for limited cognitive resources, cause mind wandering, and decrease academic, occupational, and daily life tasks performance. Among the most important factors for mind wandering, they cited worries about the latest news regarding the pandemic, worries about loved ones and others who might be at risk health-wise or financially, and worries about themselves. Overall, our results are consistent with their conjecture, but also reveal some further details.

TABLE 4 | Regression coefficients in the structural model for predicting the four mediator variables.

Predictor	Negative emotions		GAD-7		PSS-4		Physical symptoms	
	<i>b</i> (<i>SE_b</i>)	β	<i>b</i> (<i>SE_b</i>)	β	<i>b</i> (<i>SE_b</i>)	β	<i>b</i> (<i>SE_b</i>)	β
Confinement	1.49 (0.23)	0.51***	0.65 (0.11)	0.33***	0.35 (0.14)	0.18*	0.32 (0.10)	0.24**
Problems at home	0.03 (0.16)	0.01	-0.09 (0.11)	-0.05	0.10 (0.15)	0.05	0.04 (0.11)	0.03
Problems at work	-0.07 (0.12)	-0.02	-0.06 (0.10)	-0.03	0.06 (0.12)	0.03	0.12 (0.09)	0.09
Lack of necessities	-0.00 (0.11)	-0.00	0.05 (0.09)	0.03	0.17 (0.10)	0.09	0.15 (0.08)	0.11
Increased workload	0.13 (0.23)	0.02	0.22 (0.16)	0.05	-0.16 (0.17)	-0.04	0.55 (0.13)	0.18***
Vulnerability to stress	1.16 (0.17)	0.40***	0.97 (0.13)	0.49***	0.71 (0.13)	0.37***	0.31 (0.11)	0.23***
Neuroticism	0.33 (0.13)	0.11*	0.22 (0.10)	0.11*	0.53 (0.12)	0.27***	-0.01 (0.09)	-0.00
General health	-0.87 (0.16)	-0.22***	-0.76 (0.10)	-0.28***	-0.90 (0.11)	-0.34***	-0.63 (0.08)	-0.34***
Female gender	1.28 (0.26)	0.18***	1.00 (0.17)	0.21***	0.45 (0.18)	0.10*	0.33 (0.15)	0.10*
Age	-0.06 (0.01)	-0.31***	-0.04 (0.01)	-0.29***	-0.04 (0.01)	-0.32***	-0.01 (0.00)	-0.10*

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The Impact of Stressors on COVID-19 Stress Responses

Previous studies have shown that stressors have an important impact on negative emotions, depression, and anxiety (Stein and Lang, 2002; Kemeny, 2003; Scott et al., 2013; Chattarji et al., 2015; Zhaoyang et al., 2020). In our study, increased workload, most likely due to increased teleworking and the need to adapt to the new situation (adjusting daily schedule and work process to work from home, helping children with online learning, increased use of computers and digital communication, etc.) contributed to physical symptoms (i.e., increased fatigue, decreased sleep quality, physical pain, and exacerbation of illness). Among the specific stressors associated with COVID-19 crisis, confinement was found to be the single most important origin of affective responses to stress and physical symptoms. It is possible that this predictor covered other stressful aspects of COVID-19 lockdown, as it was positively associated with changes in work or study conditions, income reductions, and problems with relationships at home (see **Supplementary Table 2**).

Other studies also found confinement or its variants to be important stressors during the COVID-19 epidemic. For example, Xin et al. (2020) found that mandatory quarantine during the initial COVID-19 outbreak in China was associated with negative thoughts (perceived discrimination) and emotional distress. Tang et al. (2020) found that the likelihood of exhibiting generalized anxiety and depression was higher among respondents who were quarantined than those who were not. Ammar et al. (2021b) reported that COVID-19 home confinement negatively affects mental wellbeing and emotional status and leads to unhealthy diet behaviors. Trabelsi et al. (2021) confirmed the effects of confinement on impaired sleep quality and decreases in physical activity. Bai et al. (2004), who studied the effects of quarantine during the outbreak of various diseases, found an increase in exhaustion, anxiety, irritability, and insomnia. Similarly, our results show a very general effect of this stressor on emotional, cognitive, and physical functioning during the epidemic. The negative effect of confinement could be attributed to quarantine-induced boredom, frustrations, perceived loss of freedom, decreased physical activity, (daily) travel restrictions, altered schedule due to working or studying from home, altered sleep-wake rhythms, and anxiety due to myths, misinformation, erroneous news reports in the media, and misunderstanding of health-related messages (Bao et al., 2020; Saraswathi et al., 2020). The media could also contribute to the stigmatization of those infected and those who leave their homes (Gualano et al., 2020), contributing to distress. In addition, Gualano et al. (2020) found that internet use increased during the COVID-19 lockdown for three-quarters of participants, and using the internet as a source of information led to a higher likelihood of anxiety. In terms of the harmful effects of confinement, it is interesting to note that a higher prevalence of generalized anxiety disorder has also been found in prisoners (Costa et al., 2010; Dadi et al., 2016), where it has been attributed to increased exposure to deprivation of social interaction, deprivation of liberty, rigid rules, constant control of individuals and stressful situations, among other factors

(Costa et al., 2010), and similar characteristics could be attributed to the COVID-19 lockdown.

Other Factors of COVID-19 Stress Responses

In addition to the aforementioned effects of stressors, we observed an independent contribution of stress vulnerability, neuroticism, and poor general health to negative emotions, generalized anxiety, and perceived stress. Similar findings have been reported by other studies (Kemeny, 2003; Sexton et al., 2003; Schneider, 2004; Schneider et al., 2012; Scott et al., 2013; Warttig et al., 2013; Gallagher et al., 2014; Klainin-Yobas et al., 2014). Further, women reported more affective responses to stress and more physical symptoms. Gender differences in emotional, physiological, and cognitive responses to stress have also been observed in other studies (Warttig et al., 2013; Novais et al., 2017; Hodes and Epperson, 2019; Gualano et al., 2020; Liu et al., 2020). Several alternative explanations for these differences have been provided, ranging from neurobiological (Novais et al., 2017; Hodes and Epperson, 2019) to psychological in the sense that women are exposed to more stressors or perceive stressors as more stressful than men (Warttig et al., 2013). Finally, age acted as a preventive factor against affective responses to stress, as also found in several other studies (Warttig et al., 2013; Gualano et al., 2020). According to Warttig et al. (2013), older adults report fewer stressors than their younger counterparts because they are less active and redirect their preferences toward satisfying goals and emotion regulation to maximize positive emotional experiences and minimize negative ones. Also, physical symptoms may be perceived as normative in old age, so older people have a higher threshold for reporting them as potential stressors. In addition, the COVID-19 crisis likely brought fewer changes to the lives of older people (especially retirees) than to younger people.

More severe physical symptoms (i.e., greater increase in fatigue and worsening of sleep quality and health status) were reported by younger and more vulnerable individuals, by women, and by participants who reported increased workload, greater impact of confinement and poorer health. This is consistent with Wang et al.'s (2020) finding that anxiety was higher among students who reported poor health, and suggests that restricted movement during the epidemic may have exacerbated pre-existing health problems.

The Association of Physical and Affective Stress Responses With Subjective Cognitive Decline

In our model, physical symptoms and affective responses to stress were considered mediator variables in the relationship between stressors and subjective cognitive change. The results are consistent with other studies that have found subjective cognitive complaints to be associated with physical health problems (Comijs et al., 2002; Jacob et al., 2019) and sleep problems (Stenfors et al., 2013; Miley-Akerstedt et al., 2018; Jacob et al., 2019); the variables included in the construct Physical Symptoms in our study. Comijs et al. (2002) speculated

that physical problems may contribute to lower wellbeing and motivation, leading to poor performance on cognitive tasks and memory complaints.

Both subjective and objective cognitive decline have also previously been associated with negative emotions and anxiety (Comijs et al., 2002; Ouimet et al., 2009; Boals and Banks, 2012; Harlé et al., 2013; Okon-Singer et al., 2015; Hill et al., 2016; Jacob et al., 2019). In our study, we found no evidence of the association between subjective cognitive decline and generalized anxiety. One possibility for such a result could be that we found a prevalence of generalized anxiety disorder of 9% in our sample (this was the percentage of participants with GAD-7 sum greater than 10 points), which is much lower than what has been found in some other countries and subject groups, where typically about one-third of the samples had an anxiety disorder and about one-third to one-half had sleep disorders during the COVID-19 epidemic (Fu et al., 2020; Gualano et al., 2020; Huang and Zhao, 2020; Hyland et al., 2020; Twenge and Joiner, 2020; Fiorenzato et al., 2021). Unfortunately, there are no data for the prevalence of generalized anxiety disorder in Slovenia in normal times, but a 12-month prevalence of threshold GAD of about 2% was observed in the European community before the COVID-19 pandemic (Lieb et al., 2005) and a 1-month prevalence of about 8% was observed in primary care patients worldwide (Maier et al., 2000), suggesting that the prevalence of GAD was only slightly increased in our sample. The use of other, more discriminating measures of anxiety could lead to different results. The same could be true for the measure of perceived stress (PSS-4), which had low reliability. This could be one of the reasons why we found no association between the PSS-4 scale score and the CCQ score, which is not consistent with previous studies reporting that loss of perceived control is related to subjective cognitive complaints (Comijs et al., 2002; Boals and Banks, 2012; dos Santos et al., 2012; Steinberg et al., 2013).

Study Limitations and Strengths

Our study has several limitations. We used only self-report scales, which may have led to social desirability and other response biases. Second, the study was cross-sectional. At the time of our study, the epidemic had been declared in Slovenia for just over a month. The differences between our study and others in the expression of affective responses to stress could be explained by the different timing during the lockdown and the different measurement instruments used. Third, participation was voluntary, and stressed individuals may have a greater need to participate in studies, such as ours to express their concerns and problems. Fourth, snowball sampling was used, resulting in an unbalanced gender and age structure of the sample (with males and individuals older than 75 years underrepresented), so our results may not be generalizable to the general population. Fifth, as is common with online surveys, a number of participants (27%) left the survey before completing it or did not answer all questions, so attrition bias may be present (see **Supplementary Table 3** and accompanying text for

more information on this). Sixth, other relevant stressors (e.g., reduction in physical activity and social interactions) and constructs (e.g., depression) could be included in the model and instruments with better psychometric properties could be used instead of single indicator variables, but this would increase the length of the already long survey and lead to additional dropouts. Seventh, our model is unidirectional and predicts subjective cognitive change based on physical symptoms and affective responses to stress. However, the relationship between the constructs under study may be bidirectional. For example, negative emotions may increase subjective cognitive decline, and subjective cognitive decline may increase negative emotions. The lack of temporal order in the measurement of stress and subjective cognitive decline prohibits causal inferences, and the mediations in our structural model should not be interpreted as causal mediations (Maxwell and Cole, 2007). Longitudinal observation would be desirable to shed more light on psychological responses to the COVID-19 epidemic. Qualitative studies should be conducted as a complement to quantitative studies to investigate in more detail how participants experienced the lockdown and in which situations subjective cognitive decline occurred, how it changed over time and why, how the intensive use of digital technology affected it, etc. Finally, using objective measures of stress (e.g., measuring cortisol levels) to monitor physiological changes during the epidemic would provide a deeper understanding of the impact of the epidemic on physical and mental health. Future studies should also use tests of attention, memory, and executive function and address the potential objective cognitive decline caused by chronic stress due to the COVID-19 epidemic, as subjective and objective cognitive decline do not necessarily overlap in healthy adults (Markova et al., 2017; Barbe et al., 2018).

Nevertheless, we can say that our research is important because we collected the data during the critical period of the first wave of the COVID-19 epidemic, i.e., under lockdown and particular psychological circumstances, and our sample was large. A majority of our results were consistent with findings in the literature, which gives us confidence. Additional support for our findings comes from a very recently published study by Fiorenzato et al. (2021). They investigated the effect of lockdown on the mental health and cognitive functioning of Italian residents. Some findings overlap with ours. For example, their participants reported increased distress and decreased sleep quality. They also complained about their attention, temporal orientation, and executive functions during lockdown. Subjective cognitive complaints were associated with home confinement. In their study, subjective cognitive complaints were also associated with increases in anxiety and depression, female gender, younger age, and underemployment. In our study, gender and age had similar effects on mediator variables (physical symptoms and affective stress responses) but not directly on subjective cognitive decline.

An important contribution of our study is also the developed CCQ, a brief measure of recent subjective cognitive

changes. The instrument showed adequate psychometric properties and could be used and further validated in the future studies on the influence of crisis situations on subjective cognitive decline.

Conclusion

Our study showed that prolonged confinement can cause distress and lead to generalized anxiety, negative emotions, loss of perceived control, increased physical symptoms, and subjective cognitive decline. These results have several practical implications. First, governments should ensure that the experience of confinement is as tolerable as possible by setting a reasonable duration of lockdown and providing basic supplies and services (Li et al., 2020). Regulations designed to prevent the further spread of the virus must be well thought out and properly communicated to mitigate stress and prevent stress reactions. Interventions delivered via the Internet, mobile devices, or other types of media should be offered during confinement to monitor physical, mental, and psychosocial health, promote healthy lifestyles, and provide psychosocial support, especially for vulnerable groups, such as the elderly (see Ammar et al., 2021a). Second, cognitive impairment during the pandemic is inevitable for even the most resilient individuals (Boals and Banks, 2020). Therefore, attention should be paid to subjective (and objective) cognitive decline and to adapting work or learning processes during the epidemic. Expectations of what is realistic in times of crisis should be scaled down. In relation to stress, cognitive activities may have a preventive effect, as it has been shown that higher cognitive load focuses attention more on the neutral or positive non-threatening stimuli and reduces mind wandering toward worry (Najmi et al., 2015). However, according to the results of our study, increased workload can increase physical symptoms, such as fatigue and sleep problems. Therefore, a carefully planned, balanced level of work or study activities would be preferable during these difficult times.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

REFERENCES

- IKA (ver. 20.03.02) [online software] (2020). Ljubljana: Fakulteta za družbene vede. Available at: <https://www.ika.si> (Accessed December 1, 2020)
- Alhola, P., and Polo-Kantola, P. (2007). Sleep deprivation: impact on cognitive performance. *Neuropsychiatr. Dis. Treat.* 3, 553–567.
- Altena, E., Micoulaud-Franchi, J. A., Geoffroy, P. A., Sanz-Arigita, E., Bioulac, S., and Philip, P. (2016). The bidirectional relation between emotional reactivity and sleep: From disruption to recovery. *Behav. Neurosci.* 130, 336–350. doi: 10.1037/bne0000128
- Ammar, A., Bouaziz, B., Trabelsi, K., Glenn, J., Zmijewski, P., Müller, P., et al. (2021a). Applying digital technology to promote active and healthy confinement lifestyle during pandemics in the elderly. *Biol. Sport* 38, 391–396. doi: 10.5114/biolSport.2021.100149

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ethics Committee of the Faculty of Arts at University of Ljubljana. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AP and VK were involved in developing the theory and survey, planning the study, and distributed the invitations. AP set up the online survey, analyzed the data with the help of LK, and wrote the manuscript with assistance from VK. AP, LK, and VK discussed the results. LK prepared Figure 1. LK and VK commented on the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.647971/full#supplementary-material>

- Ammar, A., Trabelsi, K., Brach, M., Chtourou, H., Boukhris, O., Masmoudi, L., et al. (2021b). Effects of home confinement on mental health and lifestyle behaviours during the COVID-19 outbreak: insights from the ECLB-COVID19 multicentre study. *Biol. Sport* 38, 9–21. doi: 10.5114/biolSport.2020.96857
- Bai, Y. M., Lin, C. C., Lin, C. Y., Chen, J. Y., Chue, C. M., and Chou, P. (2004). Survey of stress reactions among health care workers involved with the SARS outbreak. *Psychiatr. Serv.* 55, 1055–1057. doi: 10.1176/appi.ps.55.9.1055
- Bao, Y., Sun, Y., Meng, S., Shi, J., and Lu, L. (2020). 2019-nCoV epidemic: address mental health care to empower society. *Lancet* 395, e37–e38. doi: 10.1016/S0140-6736(20)30309-3
- Barbe, T., Kimble, L. P., and Rubenstein, C. (2018). Subjective cognitive complaints, psychosocial factors and nursing work function in nurses providing direct patient care. *J. Adv. Nurs.* 74, 914–925. doi: 10.1111/jan.13505

- Batty, G. D., Deary, I. J., Luciano, M., Altschul, D. M., Kivimäki, M., and Gale, C. R. (2020). Psychosocial factors and hospitalisations for COVID-19: Prospective cohort study based on a community sample. *Brain Behav. Immun.* 89, 569–578. doi: 10.1016/j.bbi.2020.06.021
- Becker, S. S., Horowitz, M. J., and Campbell, L. (1973). Cognitive responses to stress: effects of changes in demand and sex. *J. Abnorm. Psychol.* 82, 519–522. doi: 10.1037/h0035215
- Boals, A., and Banks, J. B. (2012). Effects of traumatic stress and perceived stress on everyday cognitive functioning. *Cognit. Emot.* 26, 1335–1343. doi: 10.1080/02699931.2011.651100
- Boals, A., and Banks, J. B. (2020). Stress and cognitive functioning during a pandemic: thoughts from stress researchers. *Psychol. Trauma* 12, S255–S257. doi: 10.1037/tra0000716
- Bourne, L. E., and Yaroush, R. A. (2003). Stress and cognition: a cognitive psychological perspective. NASA Technical Reports Server (NTRS), February 1, 1–123. Available at: <http://psych.colorado.edu/~lbourne/StressCognition.pdf> (Accessed December 2, 2020)
- Bryce, C. P. (2001). Insights into the concept of stress. Available at: <http://helid.digicollection.org/en/d/Js2924e/5.html> (Accessed December 20, 2020)
- Chattarji, S., Tomar, A., Suvrathan, A., Ghosh, S., and Rahman, M. M. (2015). Neighborhood matters: divergent patterns of stress-induced plasticity across the brain. *Nat. Neurosci.* 18, 1364–1375. doi: 10.1038/nn.4115
- Cohen, S. (2004). Social relationships and health. *Am. Psychol.* 59, 676–684. doi: 10.1037/0003-066X.59.8.676
- Cohen, S., Gottlieb, B. H., and Underwood, L. G. (2000). “Social relationships and health,” in *Social Support Measurement and Interventions: A Guide for Health and Social Scientists*. eds. S. Cohen, L. G. Underwood, and B. H. Gottlieb (Oxford University Press, New York), 3–25. doi: 10.1093/med:psych/9780195126709.003.0001
- Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *J. Health Soc. Behav.* 24, 385–396. doi: 10.2307/2136404
- Cohen, S., Kessler, R. C., and Underwood Gordon, L. (1997). “Strategies for measuring stress in studies of psychiatric and physical disorders,” in *Measuring Stress: A Guide for Health and Social Scientists*. eds. S. Cohen, R. C. Kessler, and L. Underwood Gordon (Oxford University Press, New York), 3–26.
- Cole, M. W., Repovš, G., and Anticevic, A. (2014). The frontoparietal control system: a central role in mental health. *Neuroscientist* 20, 652–664. doi: 10.1177/1073858414525995
- Comijs, H. C., Deeg, D. J. H., Dik, M. G., Twisk, J. W. R., and Jonker, C. (2002). Memory complaints; the association with psycho-affective and health problems and the role of personality characteristics: a 6-year follow-up study. *J. Affect. Disord.* 72, 157–165. doi: 10.1016/S0165-0327(01)00453-0
- Costa, A., Fuentes, L. J., and Vivas, A. B. (2010). The impact of bilingualism on the executive control and orienting networks of attention. *Biling. Lang. Cogn.* 13, 315–325. doi: 10.1017/S1366728909990010
- Cousins, J. N., Sasmita, K., and Chee, M. W. L. (2018). Memory encoding is impaired after multiple nights of partial sleep restriction. *J. Sleep Res.* 27, 138–145. doi: 10.1111/jsr.12578
- Cox, R. C., and Olatunji, B. O. (2020). Sleep in the anxiety-related disorders: a meta-analysis of subjective and objective research. *Sleep Med. Rev.* 51:101282. doi: 10.1016/j.smrv.2020.101282
- Crawley, R., Grant, S., and Hinshaw, K. I. M. (2008). Cognitive changes in pregnancy: Mild decline or societal stereotype?. *Appl. Cogn. Psychol.* 22, 1142–1162. doi: 10.1002/acp.1427
- Dadi, A. F., Dachew, B. A., Kisi, T., Yizgaw, N., and Azale, T. (2016). Anxiety and associated factors among prisoners in north west of Amhara regional state, Ethiopia. *BMC Psychiatry* 16:83. doi: 10.1186/s12888-016-0792-y
- De Vries, J., Michielsen, H. J., and Van Heck, G. L. (2003). Assessment of fatigue among working people: a comparison of six questionnaires. *Occup. Environ. Med.* 60(Suppl. 1), i10–i15. doi: 10.1136/oem.60.suppl_1.i10
- Diamond, A. (2013). Executive functions. *Annu. Rev. Psychol.* 64, 135–168. doi: 10.1146/annurev-psych-113011-143750
- Dickerson, S. S., and Kemeny, M. E. (2004). Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychol. Bull.* 130, 355–391. doi: 10.1037/0033-2909.130.3.355
- dos Santos, A. T., Leyendecker, D. D., Costa, A. L. S., and de Souza-Talarico, J. N. (2012). Subjective memory complain in healthy elderly: influence of depressive symptoms, perceived stress and self-esteem. *Rev. Esc. Enferm. USP* 46, 24–29. doi: 10.1590/S0080-62342012000700004
- Eurofound (2020). Living, working and COVID-19 data. *Eurofound*. Available at: <https://www.eurofound.europa.eu/data/covid-19>
- Farrer, L. M., Gulliver, A., Bennett, K., Fassnacht, D. B., and Griffiths, K. M. (2016). Demographic and psychosocial predictors of major depression and generalised anxiety disorder in Australian university students. *BMC Psychiatry* 16:241. doi: 10.1186/s12888-016-0961-z
- Fiorenzato, E., Zabberoni, S., Costa, A., and Cona, G. (2021). Cognitive and mental health changes and their vulnerability factors related to COVID-19 lockdown in Italy. *PLoS One* 16:e0246204. doi: 10.1371/journal.pone.0246204
- Fu, W., Wang, C., Zou, L., Guo, Y., Lu, Z., Yan, S., et al. (2020). Psychological health, sleep quality, and coping styles to stress facing the COVID-19 in Wuhan, China. *Transl. Psychiatry* 10:225. doi: 10.1038/s41398-020-00913-3
- Gallagher, M. W., Bentley, K. H., and Barlow, D. H. (2014). Perceived control and vulnerability to anxiety disorders: a meta-analytic review. *Cogn. Ther. Res.* 38, 571–584. doi: 10.1007/s10608-014-9624-x
- Ghebreyesus, T. A. (2020). WHO Director-General’s opening remarks at the media briefing on COVID-19 - 11 March 2020. *WHO Director General’s Speeches*. Available at: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19--11-march-2020> (Accessed December 5, 2020)
- Government of the Republic of Slovenia (2020a). Slovenia declares coronavirus epidemic. *GOV.SI Portal*. Available at: <https://www.gov.si/en/news/2020-03-12-slovenia-declares-coronavirus-epidemic/> (Accessed December 5, 2020)
- Government of the Republic of Slovenia (2020b). Slovenia declares the end of COVID-19 epidemic; no quarantine for EU citizens from today. *GOV.SI Portal*. Available at: <https://www.gov.si/en/news/2020-05-15-slovenia-declares-the-end-of-covid-19-epidemic-no-quarantine-for-eu-citizens-from-today/> (Accessed December 5, 2020)
- Gualano, M. R., Lo Moro, G., Voglino, G., Bert, F., and Siliquini, R. (2020). Effects of COVID-19 lockdown on mental health and sleep disturbances in Italy. *Int. J. Environ. Res. Public Health* 17:4779. doi: 10.3390/ijerph17134779
- Harlé, K. M., Shenoy, P., and Paulus, M. P. (2013). The influence of emotions on cognitive control: feelings and beliefs-where do they meet? *Front. Hum. Neurosci.* 7:508. doi: 10.3389/fnhum.2013.00508
- Hill, N. L., Mogle, J., Wion, R., Munoz, E., DePasquale, N., Yevchak, A. M., et al. (2016). Subjective cognitive impairment and affective symptoms: a systematic review. *Gerontologist* 56, e109–e127. doi: 10.1093/geront/gnw091
- Hirotsu, C., Tufik, S., and Andersen, M. L. (2015). Interactions between sleep, stress, and metabolism: From physiological to pathological conditions. *Sleep Sci.* 8, 143–152. doi: 10.1016/j.slsci.2015.09.002
- Hodes, G. E., and Epperson, C. N. (2019). Sex differences in vulnerability and resilience to stress across the life span. *Biol. Psychiatry* 86, 421–432. doi: 10.1016/j.biopsych.2019.04.028
- Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 288:112954. doi: 10.1016/j.psychres.2020.112954
- Hyland, P., Shevlin, M., McBride, O., Murphy, J., Karatzias, T., Bentall, R. P., et al. (2020). Anxiety and depression in the Republic of Ireland during the COVID-19 pandemic. *Acta Psychiatr. Scand.* 142, 249–256. doi: 10.1111/acps.13219
- Jacob, L., Haro, J. M., and Koyanagi, A. (2019). Physical multimorbidity and subjective cognitive complaints among adults in the United Kingdom: a cross-sectional community-based study. *Sci. Rep.* 9:12417. doi: 10.1038/s41598-019-48894-8
- Jessen, F. (2014). Subjective and objective cognitive decline at the pre-dementia stage of Alzheimer’s disease. *Eur. Arch. Psychiatry. Clin. Neurosci.* 264, 3–7. doi: 10.1007/s00406-014-0539-z
- Jessen, F., Amariglio, R. E., Van Boxtel, M., Breteler, M., Ceccaldi, M., Chételat, G., et al. (2014). A conceptual framework for research on subjective cognitive decline in preclinical Alzheimer’s disease. *Alzheimers Dement* 10, 844–852. doi: 10.1016/j.jalz.2014.01.001
- Kavčič, V., and Podlesek, A. (2020). “Samoocena anksioznosti med epidemijo COVID-19 v Sloveniji [Self-assessed anxiety during the COVID-19 epidemic in Slovenia],” in *Psihologija pandemije: Posamezniki in družba v času koronske krize [Psychology of a Pandemic: Individuals and the Society in Times of Corona Crisis]*. eds. Ž. Lep and K. H. Beyazoglu (Ljubljana, Slovenia: Znanstvena založba Filozofske fakultete Univerze v Ljubljani), 105–116.

- Kemeny, M. E. (2003). The psychobiology of stress. *Curr. Dir. Psychol. Sci.* 12, 124–129. doi: 10.1111/1467-8721.01246
- Khanade, K., and Sasangohar, F. (2017). Stress, fatigue, and workload in intensive care nursing: a scoping literature review. *Proc. Hum. Factors Ergon. Soc.* 61, 686–690. doi: 10.1177/1541931213601658
- Klainin-Yobas, P., Keawkerd, O., Pumpuang, W., Thunyadee, C., Thanoi, W., and He, H. G. (2014). The mediating effects of coping on the stress and health relationships among nursing students: a structural equation modelling approach. *J. Adv. Nurs.* 70, 1287–1298. doi: 10.1111/jan.12283
- Kocalevent, R. D., Hinz, A., Brähler, E., and Klapp, B. F. (2011). Determinants of fatigue and stress. *BMC Res. Notes* 4:238. doi: 10.1186/1756-0500-4-238
- Krueger, G. P. (1989). Sustained work, fatigue, sleep loss and performance: a review of the issues. *Work Stress.* 3, 129–141. doi: 10.1080/02678378908256939
- Kryla-Lighthall, N., and Mather, M. (2009). “The role of cognitive control in older adults’ well-being,” in *Handbook of Theories of Aging. 2nd Edn.* eds. V. Bengtson, D. Gans, N. Putney and M. Silverstein. (New York: Springer Publishing Company), 323–344.
- Lep, Ž., and Hacin Beyazoglu, K. (2020). *Psihologija pandemije: Posamezniki in družba v času koronske krize [Psychology of a Pandemic: Individuals and the Society in Times of Corona Crisis]*. Ljubljana, Slovenia: Znanstvena založba Filozofske fakultete Univerze v Ljubljani.
- Li, H. Y., Cao, H., Leung, D. Y. P., and Mak, Y. W. (2020). The psychological impacts of a COVID-19 outbreak on college students in China: a longitudinal study. *Int. J. Environ. Res. Public Health* 17:3933. doi: 10.3390/ijerph17113933
- Lieb, R., Becker, E., and Altamura, C. (2005). The epidemiology of generalized anxiety disorder in Europe. *Eur. Neuropsychopharmacol.* 15, 445–452. doi: 10.1016/j.euroneuro.2005.04.010
- Liston, C., McEwen, B. S., and Casey, B. J. (2009). Psychosocial stress reversibly disrupts prefrontal processing and attentional control. *Proc. Natl. Acad. Sci. U. S. A.* 106, 912–917. doi: 10.1073/pnas.0807041106
- Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter. *Psychiatry Res.* 287:112921. doi: 10.1016/j.psychres.2020.112921
- Maier, W., Gänssicke, M., Freyberger, H. J., Linz, M., Heun, R., and Lecrubier, Y. (2000). Generalized anxiety disorder (ICD-10) in primary care from a cross-cultural perspective: a valid diagnostic entity? *Acta Psychiatr. Scand.* 101, 29–36. doi: 10.1034/j.1600-0447.2000.101001029.x
- Markova, H., Anđel, R., Stepankova, H., Kopecek, M., Nikolai, T., Hort, J., et al. (2017). Subjective cognitive complaints in cognitively healthy older adults and their relationship to cognitive performance and depressive symptoms. *J. Alzheimers Dis.* 59, 871–881. doi: 10.3233/JAD-160970
- Marsh, H. W., Wen, Z., and Hau, K. T. (2004). Structural equation models of latent interactions: evaluation of alternative estimation strategies and indicator construction. *Psychol. Methods* 9, 275–300. doi: 10.1037/1082-989X.9.3.275
- Mathews, A., and MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annu. Rev. Clin. Psychol.* 1, 167–195. doi: 10.1146/annurev.clinpsy.1.102803.143916
- Maxwell, S. E., and Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. *Psychol. Methods* 12, 23–44. doi: 10.1037/1082-989X.12.1.23
- Miley-Akerstedt, A., Jelic, V., Marklund, K., Walles, H., Åkerstedt, T., Hagman, G., et al. (2018). Lifestyle factors are important contributors to subjective memory complaints among patients without objective memory impairment or positive neurochemical biomarkers for Alzheimer’s disease. *Dement. Geriatr. Cogn. Dis. Extra* 8, 439–452. doi: 10.1159/000493749
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., and Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cogn. Psychol.* 41, 49–100. doi: 10.1006/cogp.1999.0734
- Möhrling, K., Naumann, E., Reifenscheid, M., Wenz, A., Rettig, T., Krieger, U., et al. (2020). The COVID-19 pandemic and subjective well-being: longitudinal evidence on satisfaction with work and family. *Eur. Soc.* 23(Suppl. 1), S601–S617. doi: 10.1080/14616696.2020.1833066
- Najmi, S., Amir, N., Frosio, K. E., and Ayers, C. (2015). The effects of cognitive load on attention control in subclinical anxiety and generalised anxiety disorder. *Cognit. Emot.* 29, 1210–1223. doi: 10.1080/02699931.2014.975188
- Novais, A., Monteiro, S., Roque, S., Correia-Neves, M., and Sousa, N. (2017). How age, sex and genotype shape the stress response. *Neurobiol. Stress* 6, 44–56. doi: 10.1016/j.ynstr.2016.11.004
- Okon-Singer, H., Hendler, T., Pessoa, L., and Shackman, A. J. (2015). The neurobiology of emotion-cognition interactions: fundamental questions and strategies for future research. *Front. Hum. Neurosci.* 9:58. doi: 10.3389/fnhum.2015.00058
- Ouimet, A. J., Gawronski, B., and Dozois, D. J. A. (2009). Cognitive vulnerability to anxiety: a review and an integrative model. *Clin. Psychol. Rev.* 29, 459–470. doi: 10.1016/j.cpr.2009.05.004
- Pallavicini, F., Gaggioli, A., Raspelli, S., Cipresso, P., Serino, S., Vigna, C., et al. (2013). Interreality for the management and training of psychological stress: study protocol for a randomized controlled trial. *Trials* 14:191. doi: 10.1186/1745-6215-14-191
- Paredes, M. R., Apaolaza, V., Fernandez-Robin, C., Hartmann, P., and Yañez-Martinez, D. (2021). The impact of the COVID-19 pandemic on subjective mental well-being: the interplay of perceived threat, future anxiety and resilience. *Personal. Individ. Differ.* 170:110455. doi: 10.1016/j.paid.2020.110455
- Pinto, J., van Zeller, M., Amorim, P., Pimentel, A., Dantas, P., Eusébio, E., et al. (2020). Sleep quality in times of Covid-19 pandemic. *Sleep Med.* 74, 81–85. doi: 10.1016/j.sleep.2020.07.012
- Podlesek, A., and Kavčič, V. (2020). “Stres in samoznane kognitivne spremembe med epidemijo COVID-19 [Stress and self-perceived cognitive changes during the COVID-19 epidemic],” in *Psihologija pandemije: Posamezniki in družba v času koronske krize [Psychology of a Pandemic: Individuals and the Society in Times of Corona Crisis]*. eds. Ž. Lep and K. H. Beyazoglu (Ljubljana, Slovenia: Znanstvena založba Filozofske fakultete Univerze v Ljubljani), 143–154.
- Podlesek, A., and Kavčič, V. (2021). Generalized anxiety in Slovenian university students during the COVID-19 epidemic. *Sodobna Pedagogika* 72, 322–341.
- Qi, M., Zhou, S.-J., Guo, Z.-C., Zhang, L.-G., Min, H.-J., Li, X.-M., et al. (2020). The effect of social support on mental health in Chinese adolescents during the outbreak of COVID-19. *J. Adolesc. Health* 67, 514–518. doi: 10.1016/j.jadohealth.2020.07.001
- Qin, S., Hermans, E. J., Van Marle, H. J., Luo, J., and Fernández, G. (2009). Acute psychological stress reduces working memory-related activity in the dorsolateral prefrontal cortex. *Biol. Psychiatry.* 66, 25–32. doi: 10.1016/j.biopsych.2009.03.006
- Revelle, W. (2015). Package “psych” - Procedures for psychological, psychometric and personality research. *R Package*, 1–358. Available at: <https://personality-project.org/r/psych/> (Accessed December 29, 2020)
- Rosseel, Y. (2012). Lavaan: an R package for structural equation modeling. *J. Stat. Softw.* 48, 1–36. doi: 10.18637/jss.v048.i02
- Saraswathi, I., Saikarthik, J., Kumar, K. S., Srinivasan, K. M., Ardhanaari, M., and Gunapriya, R. (2020). Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. *PeerJ* 8:e10164. doi: 10.7717/peerj.10164
- Schneider, T. R. (2004). The role of neuroticism on psychological and physiological stress responses. *J. Exp. Soc. Psychol.* 40, 795–804. doi: 10.1016/j.jesp.2004.04.005
- Schneider, T. R., Rench, T. A., Lyons, J. B., and Riffle, R. R. (2012). The influence of neuroticism, extraversion and openness on stress responses. *Stress. Health* 28, 102–110. doi: 10.1002/smi.1409
- Schneiderman, N., Ironson, G., and Siegel, S. D. (2005). Stress and health: psychological, behavioral, and biological determinants. *Annu. Rev. Clin. Psychol.* 1, 607–628. doi: 10.1146/annurev.clinpsy.1.102803.144141
- Scott, S. B., Sliwinski, M. J., and Blanchard-Fields, F. (2013). Age differences in emotional responses to daily stress: the role of timing, severity, and global perceived stress. *Psychol. Aging* 28, 1076–1087. doi: 10.1037/a0034000
- Scullin, M. K., and Bliwiese, D. L. (2015). Sleep, cognition, and normal aging: integrating a half century of multidisciplinary research. *Perspect. Psychol. Sci.* 10, 97–137. doi: 10.1177/1745691614556680
- Sexton, K. A., Norton, P. J., Walker, J. R., and Norton, G. R. (2003). Hierarchical model of generalized and specific vulnerabilities in anxiety. *Cogn. Behav. Ther.* 32, 82–94. doi: 10.1080/16506070320321
- Shields, G. S., Sazma, M. A., and Yonelinas, A. P. (2016). The effects of acute stress on core executive functions: A meta-analysis and comparison with

- cortisol. *Neurosci. Biobehav. Rev.* 68, 651–668. doi: 10.1016/j.neubiorev.2016.06.038
- Spielberger, C. D. (1966). “Theory and research on anxiety,” in *Anxiety and Behavior*. ed. C. D. Spielberger (New York: Academic Press), 3–20.
- Spitzer, R. L., Kroenke, K., Williams, J. B., and Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.* 166, 1092–1097. doi: 10.1001/archinte.166.10.1092
- Statistical Office of the Republic of Slovenia (2020). *SiStat database*. Available at: <https://pxweb.stat.si/SiStatData/pxweb/sl/Data/Data/05C4004S.px/> (Accessed December 10, 2020)
- Stein, M. B., and Lang, A. J. (2002). “Anxiety and stress disorders: course over the lifetime,” in *Neuropsychopharmacology. The Fifth Generation of Progress*. eds. K. L. Davis, D. Charney, J. T. Coyle, and C. Nemeroff (Philadelphia, PA: Lippincott Williams & Wilkins) 859–866.
- Steinberg, S. I., Negash, S., Sammel, M. D., Bogner, H., Harel, B. T., Livney, M. G., et al. (2013). Subjective memory complaints, cognitive performance, and psychological factors in healthy older adults. *Am. J. Alzheimers Dis. Other Dement.* 28, 776–783. doi: 10.1177/1533317513504817
- Stenfors, C. U. D., Marklund, P., Magnusson Hanson, L. L., Theorell, T., and Nilsson, L.-G. (2013). Subjective cognitive complaints and the role of executive cognitive functioning in the working population: a case-control study. *PLoS One* 8:e83351. doi: 10.1371/journal.pone.0083351
- Tang, F., Liang, J., Zhang, H., Kelifa, M. M., He, Q., and Wang, P. (2020). COVID-19 related depression and anxiety among quarantined respondents. *Psychol. Health* 36, 164–178. doi: 10.1080/08870446.2020.1782410
- Taylor, A. H., and Dorn, L. (2006). Stress, fatigue, health, and risk of road traffic accidents among professional drivers: the contribution of physical inactivity. *Annu. Rev. Public Health* 27, 371–391. doi: 10.1146/annurev.publhealth.27.021405.102117
- Thorsteinsson, E. B., Brown, R. F., and Owens, M. T. (2019). Modeling the effects of stress, anxiety, and depression on rumination, sleep, and fatigue in a nonclinical sample. *J. Nerv. Ment. Dis.* 207, 355–359. doi: 10.1097/NMD.0000000000000973
- Thorell, L. B., Lazarević, N. F., Milovanović, I., and Bugarski Ignjatović, V. (2020). Psychometric properties of the Teenage Executive Functioning Inventory (TEXI): A freely available questionnaire for assessing deficits in working memory and inhibition among adolescents. *Child Neuropsychol.* 26, 857–864. doi: 10.1080/09297049.2020.1726885
- Trabelsi, K., Ammar, A., Masmoudi, L., Boukhris, O., Chtourou, H., Bouaziz, B., et al. (2021). Globally altered sleep patterns and physical activity levels by confinement in 5056 individuals: ECLB COVID-19 international online survey. *Biol. Sport* 38, 495–506. doi: 10.5114/biolSport.2021.101605
- Trizano-Hermosilla, I., and Alvarado, J. M. (2016). Best alternatives to Cronbach’s alpha reliability in realistic conditions: congeneric and asymmetrical measurements. *Front. Psychol.* 7:769. doi: 10.3389/fpsyg.2016.00769
- Twenge, J. M., and Joiner, T. E. (2020). U.S. Census Bureau-assessed prevalence of anxiety and depressive symptoms in 2019 and during the 2020 COVID-19 pandemic. *Depress. Anxiety* 37, 954–956. doi: 10.1002/da.23077
- Tyng, C. M., Amin, H. U., Saad, M. N. M., and Malik, A. S. (2017). The influences of emotion on learning and memory. *Front. Psychol.* 8:1454. doi: 10.3389/fpsyg.2017.01454
- Uchino, B. N. (2009). Understanding the links between social support and physical health: a life-span perspective with emphasis on the separability of perceived and received support. *Perspect. Psychol. Sci.* 4, 236–255. doi: 10.1111/j.1745-6924.2009.01122.x
- Valerio, T. D., Kim, J., Sexton-Radek, K., and Kim, M. J. (2016). Association of stress, general health, and alcohol use with poor sleep quality among U.S. college students. *Am. J. Health Educ.* 47, 17–23. doi: 10.1080/19325037.2015.1111173
- Vallat-Azouvi, C., Pradat-Diehl, P., and Azouvi, P. (2012). The Working Memory Questionnaire: A scale to assess everyday life problems related to deficits of working memory in brain injured patients. *Neuropsychol. Rehabil.* 22, 634–649. doi: 10.1080/09602011.2012.681110
- Van Reeth, O., Weibel, L., Spiegel, K., Leproult, R., Dugovic, C., and Maccari, S. (2000). Interactions between stress and sleep: from basic research to clinical situations. *Sleep Med. Rev.* 4, 201–219. doi: 10.1053/smr.1999.0097
- Wang, Z. H., Yang, H. L., Yang, Y. Q., Liu, D., Li, Z. H., Zhang, X. R., et al. (2020). Prevalence of anxiety and depression symptom, and the demands for psychological knowledge and interventions in college students during COVID-19 epidemic: a large cross-sectional study. *J. Affect. Disord.* 275, 188–193. doi: 10.1016/j.jad.2020.06.034
- Warttig, S. L., Forshaw, M. J., South, J., and White, A. K. (2013). New, normative, English-sample data for the short form perceived stress scale (PSS-4). *J. Health Psychol.* 18, 1617–1628. doi: 10.1177/1359105313508346
- Xiao, H., Zhang, Y., Kong, D., Li, S., and Yang, N. (2020). Social capital and sleep quality in individuals who self-isolated for 14 days during the coronavirus disease 2019 (COVID-19) outbreak in January 2020 in China. *Med. Sci. Monit.* 26:e923921. doi: 10.12659/MSM.923921
- Xin, M., Luo, S., She, R., Yu, Y., Li, L., Wang, S., et al. (2020). Negative cognitive and psychological correlates of mandatory quarantine during the initial COVID-19 outbreak in China. *Am. Psychol.* 75, 607–617. doi: 10.1037/amp0000692
- Yiend, J. (2010). The effects of emotion on attention: a review of attentional processing of emotional information. *Cognit. Emot.* 24, 3–47. doi: 10.1080/02699930903205698
- Zavec, Z., Nagy, T., Galkó, A., Nemeth, D., and Janacsek, K. (2020). The relationship between subjective sleep quality and cognitive performance in healthy young adults: Evidence from three empirical studies. *Sci. Rep.* 10:4855. doi: 10.1038/s41598-020-61627-6
- Zhaoyang, R., Scott, S. B., Smyth, J. M., Kang, J. E., and Sliwinski, M. J. (2020). Emotional responses to stressors in everyday life predict long-term trajectories of depressive symptoms. *Ann. Behav. Med.* 54, 402–412. doi: 10.1093/abm/kaz057

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The Moderation Effects of Comparative Thinking Between Gratitude and Negative Affect During the COVID-19 Outbreak

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The aim of this research was to examine the moderation effects of comparative thinking (CT) across the relationship between gratitude and affect during the COVID-19 outbreak. To this purpose, multiple regression as well as moderation analyses were carried out. Age and sex were also addressed as variables of interest as described in previous literature. A sample of 306 north Americans was recruited by crowdsourcing platform ProA to obtain a representative sample based on age and gender. The participants filled in a questionnaire based on comparative thinking in relation to the emotional experience experienced before and during the COVID-19 outbreak, positive and negative affect schedule for positive and negative affect, as well as Gratitude Questionnaire - Six Items Form scores for gratitude. The main results of the current study related to the COVID-19 outbreak can be listed as follows: (i) no differences between CT groups in the gratitude trait, but differences in positive and negative affect did occur; (ii) regression models that included age, gratitude, and affect variables predicted negative and positive affects but gender did not reach the statistical level; (iii) two moderation models predicted affect from gratitude, with the CT variable moderating this effect; this moderation effect was also statistically significant in predicting negative affect but it was not statistically significant in predicting positive affect. These results might be of interest for training programs in applied levels and theoretical models of gratitude.

Keywords: COVID-19, positive affect, negative affect, gratitude, gender

INTRODUCTION

Contemporary society has been facing the urgent psychological need for support in an unprecedented health crisis worldwide. This is expected to be followed by an economic crisis of greater impact than that of 2008. Unsurprisingly, this has also raised not only the interest of the scientific community, but also the general public, raising many issues of debate that involve a large body of disciplines in our society. Even though research on this virus has

growth exponentially in the last months, there are currently many doubts regarding its mode of transmission and its presentations, in addition to intensive efforts to develop vaccines and therapies. Within this scenario, priority has been given to the biomedical aspect. However, the global psychological impact of this pandemic is still unknown, and merits thoughtful consideration.

Recent studies suggest that the current situation will have a significant psychological impact and an increase on psychological disorders (Duan and Zhu, 2020; Zgueb et al., 2020). A large body of studies has addressed the restriction measures effects in wellbeing and other underlying variables to behavior during lockdown. According to Ammar et al.'s (2020a) findings in Europe, North Africa, West Asia, and America, a psychosocial strain occurs due to large decreases in the amount of social activity through family, friends/neighbors, or entertainment, as well as, lower life satisfaction due to a decrease in mental wellbeing and an increase in depressive symptoms when comparing previous states to confinement (Ammar et al., 2020b). Early studies in China reported that most of the symptoms affecting people in confinement were fear of contagion, anxiety caused by isolation, and lack of information regarding the new virus (Huang and Zhao, 2020). For example, Wang et al. (2020) reported a moderate to severe psychological impact as up to 20% of participants experienced noteworthy depressive symptoms. The role of attitudes towards the COVID-19 outbreak is of interest to describe different profiles in the population that improve adherence to health recommendations (Murphy and Moret-Tatay, 2021). In this way, studies on protective factors seem to be imperative for mental health as well as other inherent fields.

From theoretical models and applied evidence, it has been highlighted how stressful life events can be determinants for many fields (Assari and Lankarani, 2016). Gratitude emerges as a construct of interest in the field of mental health. It has been described as a variable related to happiness, health, purpose in life, and other desirable life outcomes but also related to a decrease in negative affect and vice versa (Rash et al., 2011; Emmons et al., 2019). According to Syropoulos and Markowitz (2020), gratitude is related to various behavioral, affective, and attitudinal responses to the pandemic. Moreover, the authors investigated how this construct is related to moral decisions and response to COVID-19 concluding a positive impact on prosociality. In a previous study, we have found that the four subscales of gratitude (Interpersonal Gratitude, Gratitude in the face of Suffering, Recognition of Gifts, and Expression of Gratitude) were positively associated with positive affect as well as inversely associated with negative affect, indicating that people who are more grateful, both to other people and to transcendental forces, experience a better affective experience (Bernabe-Valero et al., 2021). Moreover, higher scores on gratitude have been also found to be predictors of a lower impact to academic functioning at the end of the semester during the current COVID-19 outbreak (Bono et al., 2020). Thus, we highlight the interest in studying gratitude during the COVID-19 pandemic as it has been found to emerge as a protective factor with numerous benefits for both physical

and psychological health (i.e., Emmons and Mishra, 2011) and specifically plays an important role in post-traumatic growth (Linley and Joseph, 2004).

Whether gratitude can be considered a trait or composed effect of states is a subject of much debate in the literature (Wood et al., 2008; Solom et al., 2017). It should be noted that the relationships between the trait of gratitude and daily moods, as well as how this trait behaves in adverse situations such as the current pandemic, are of interest from several perspectives. Not surprisingly, the relationships between the state of gratitude, mood, and traits were investigated from an empirical level, finding that the trait of gratitude was associated with measures of experiences and expressions of gratefulness and appreciation in daily life (e.g., McCullough et al., 2002). Moreover, it was found that measures of gratitude, as an affective trait, are useful for predicting several dimensions of gratitude in people's daily interpersonal and emotional experience (McCullough et al., 2004). These authors concluded that grateful moods are created both through top-down effects (i.e., the effects of personality and affective traits), bottom-up effects (i.e., the effects of discrete interpersonal and emotional episodes), and the interaction of these effects, providing, in this way, a view of how the three levels of affect affective traits, moods, and emotions are linked (McCullough et al., 2004). With regards to COVID-19, the literature has tried to address to what extent might current experiences explain the relations between traits with general negative appraisal. It was pointed out that situational characteristics often substantially explain the associations of traits with ratings and wellbeing (Kuper et al., 2021).

Another topic that has been addressed in relation to the current pandemic is comparative thinking (e.g., Jahan, 2020). Psychological research has demonstrated how deeply comparisons pervade our thinking (Mussweiler and Epstude, 2009) and the tendency toward comparative information processing is striking because of its remarkable ubiquity. At the time of confinement and the pandemic, many people will have thought about what their life would be like if they were not living in this situation. Moreover, if they could return to the previous state of normality, comparing either their previous life with a standard or imagining their current life without COVID-19. Counterfactual thinking is a type of comparative thinking and can be defined as a process of mentally generating alternatives to a situation (Roese, 1997). Its key feature is the juxtaposition of one's current status against an imagined better or worse alternative state (Epstude and Roese, 2008). An upward counterfactual is generated when people imagine better alternative states as opposed to a downward counterfactual which is when they imagine worse alternative states (Broomhall et al., 2017). Thus, studies have been found that link gratitude with counterfactual thinking (e.g., McNamara et al., 2003; Nicuța and Constantine, 2021). For example, Teigen (1997) required participants to tell a story of their own regarding two situations in which they had felt grateful and then asked them whether they had thought about what might have happened instead (i.e., whether they had engaged in counterfactual thinking), finding a strong

relationship between gratitude and counterfactual thinking. In another study with adolescents, it was found that after engaging in downward comparative thinking, participants reported more gratitude, and levels of negative emotion were decreased (Nicuța and Constantine, 2021). A meta-analysis examined the strength of association between upward counterfactual thinking and depressive symptoms and found that upward counterfactuals and regret produced statistically significant positive effects that were similar in strength and effects. Results also did not vary as a function of the subject related to counterfactual-inducing situations or study designs (in terms of cross-sectional vs. longitudinal), or even different measurement methods (Broomhall et al., 2017). Thus, it is of interest to clarify the role of comparative thinking, both downward and upward, in gratitude and affect. A large body of research has demonstrated that on the level of simple judgments, people engage in comparative thinking (Mussweiler and Epstude, 2009) alluding to comparative judgment as the result of the comparative thinking process. In this study, we are interested in the role of comparative thinking in relation to the emotions and affects experienced in the pandemic.

In this way, we consider that a person's categorization of their emotional state in a judgment could act as an affective schema that influences their daily affect. In other words, we hypothesize that, for example, if a person summarizes and labels their experience in a predominantly negative way (i.e., indicates that they are *worse* since the pandemic) this will influence their affect, increasing their negativity or reducing their positivity, obtaining different effects if they consider their experience to be *equal* or *better*. Moreover, given that this is comparative thinking, other counterfactual processes may come into play, since a previous situation is compared with the current experience of a pandemic. We therefore consider it interesting to see whether this comparative thinking moderates the existing beneficial effect between gratitude and affectivity. Furthermore, it must be taken into account that some situations that have occurred in the pandemic (such as losses, experiences of uncertainty, among others), have modified individual's emotional and affective states. In this way, comparisons will necessarily include the result of these experiences, which is a crucial aspect in the field. The aim of this study is to examine the role of comparative thinking regarding COVID-19 on the relationship between gratitude and emotional affect. Age is a variable of interest as differences have been described for gratitude with regard to lifespan (Jiang, 2020). Although the general consensus is that older people exhibit a feeling of greater wellbeing and less negative affectivity in a pandemic (Bernabe-Valero et al., 2021), a research found that older adults showed higher positive affect and lower negative affect in comparison to younger adults, but similar patterns were found for both groups (Ebert et al., 2020). On the other hand, gender differences have been reported on affect during the COVID-19 outbreak in some studies (Terry et al., 2020; Pérez-Mengual et al., 2021) while others (i.e., Cao et al., 2020; Zhang and Ma, 2020) found no differences, reflecting inconsistent results that require further clarification. For this reason, these variables are considered in the current study.

MATERIALS AND METHODS

Participants

Three hundred and six (306) participants were recruited from the prolific platform ProA, with the condition that the entire sample be residents of the United States, whose main language is English. Four participants were excluded because they did not meet this criterion, leaving a sample of 302 participants of which 153 (51%) were women and 149 (49%) were men. A cross-sectional design was used in which ages ranging from 19 to 82 years ($M=45.07$, $ST=15.94$) were represented. The participants were divided into the following age ranges: 22% between 18 and 29 years old, 17% between 30 and 39 years old, 15% between 40 and 49 years old, 21% between 50 and 59 years old, and 25% were 60 years and older. Regarding ethnicity: 8% were Asian; 15% Black; 5% were of mixed race, 3% other, and 69% white. As this was a study involving human participants, it was reviewed and approved by the home University Ethical Committee.

Materials

Before administering the questionnaires, several sociodemographic questions were collected. Specifically, these were related to socio-personal data, age, sex, education level, profession, and employment status.

Comparative thinking in COVID-19 was measured with the question: "*We are currently in a worldwide pandemic situation due to COVID-19. Has this significantly affected your mood and emotions?*" Three answers were possible: "*Yes, I am feeling worse*," "*No, no change or almost no change*," "*Yes, I am better*." This question assessed the participants' choice about the emotions and affect experienced by comparing the current experience (during the pandemic) and the situation before the pandemic, which is why we call it comparative thinking (CT). We considered that this choice could be the result of a counterfactual thinking process, with an upward counterfactual process occurring when people imagine better alternative states, as opposed to a downward counterfactual process when people imagine worse alternative states. In answering this question, participants chose which response described their state, whether it was upward vs. downward. In order to be able to analyze the comparative thinking, the sample was divided into two levels; the "worse" response group and the "equal or better" one.

Once completed, different measures of gratitude and affect were administered. The instruments are described as follows:

Gratitude Questionnaire - Six Items Form

This questionnaire focuses on the emotional component of gratitude (Hudecek et al., 2020) based on an understanding of the concept of gratitude as "a generalized tendency to recognize and respond with grateful emotion to the roles of other people's benevolence in the positive experiences and outcomes that one obtains" (McCullough et al., 2002, p. 112). The internal consistency of the instrument in its construction was high, being $\alpha=0.82$. It should be noted that item number 6 was removed for theoretical and empirical

reasons (see more in Chen et al., 2008; Bernabe-Valero et al., 2013, 2020, 2019; Hudecek et al., 2020). The final GQ-5 internal consistency was $\alpha=0.89$. Responses ranged from 1 to 7 on a seven-point Likert scale (1=strongly disagree and 7=strongly agree). Scores ranged from 5 to 35, with higher scores indicating a higher level of gratitude.

The Positive and Negative Affect Schedule

A total of 20 emotion words, divided into 10 positive affect factors and 10 negative affect ones. It was developed by Watson et al. (1988). Participants must rate the degree to which they endorse each item on a rating scale (1=very slightly or not at all; 5=extremely). Items are divided to create a score for two factors: positive affect and negative affect. Higher scores represent greater endorsement of the construct. Internal consistency was optimal as positive affect depicted an $\alpha=0.90$, and negative affect, $\alpha=0.91$.

Procedure

This study had the approval from the University ethics committee (number UCV2017-2018-28), in accordance with the Declaration of Helsinki of the World Medical Association.

Participation in this research was voluntary and completely anonymous. A recruitment email was sent via the Prolific platform in the United States. At the beginning of the web-based survey, informed consent information was displayed and therefore accepted by every participant. The questionnaire was available online in May 2020.

Data Analysis

The analyses were developed through SPSS 22 and Hayes macro for SPSS (2015). After a descriptive approach, assumptions of normality and homogeneity analyses were carried out, prior to further analyses. Secondly, a relational analysis was carried out, as well as linear regression was performed, to make predictions about the variables of interest. Lastly, two moderation analyses were carried out. Regression-based procedures were executed, employing bootstrapping procedures using 10,000 samples (MacKinnon and Fairchild, 2009; Moret-Tatay et al., 2018).

RESULTS

With regard to CT, 51.6% of the participants reported an upward counterfactual process, reporting that they were *worse*, while 48.4% reported a downward counterfactual process, being *equal or even better*. Descriptive analysis as well as Pearson's coefficients are depicted in **Table 1**. A *t*-student test for independent samples was carried out (upward vs. downward) after examining equality of variances which was assumed according to Levene's test for variances ($p>0.05$). It should be noted that the upward group depicted lower values on positive affect scores and higher values in negative affect scores than the downward group. In terms of gratitude scores, differences did not reach the statistical level between groups.

Gratitude did correlate with positive affect in a direct way and vice versa for the negative affect.

Secondly, a lineal regression in the prediction of negative and positive affect scores was carried out. The model was statistically significant for negative affect, as described as follows: $F_{(5,295)}=37.08$; $MSE=1678.48$; $R^2=0.38$; $p<0.001$. Moreover, the model was also statistically significant for positive affect: $F_{(5,295)}=39.28$; $MSE=1570.35$; $R^2=0.40$; $p<0.001$. Coefficients are depicted in **Table 2**. Gender and CT were considered as dummy variables in the model.

Lastly, a moderation model on CT over the relationship between gratitude and positive and negative affect was carried out. Moreover, **Figure 1** depicts the proposed models and interactions. While CT did moderate the relationship between gratitude and negative effect, this was not the case for the relationship between gratitude and positive affect. In the first case, the moderation model on negative affect was statistically significant: $F_{(3,300)}=52.24$; $MSE=0.70$; $R^2=0.30$; $p<0.001$. Coefficients depicted in **Figure 1**, as well as the interaction, also reached the statistical level. Particularly, the R^2 increase due to the interaction depicted the following values: $R^2=0.01$; $p<0.05$. On the other hand, the moderation model on positive affect was statistically significant: $F_{(3,300)}=58.62$; $MSE=0.66$; $R^2=0.34$; $p<0.001$. Even if coefficients depicted in **Figure 1** were statistically significant, the interaction was not ($p=0.29$). The conditional effect of gratitude on negative affect at values of the moderator is described in **Table 3**.

DISCUSSION AND CONCLUSION

The aim of this work was to examine the moderation role of CT on the relationship between gratitude and positive and negative affect. Of note, literature points toward gender differences on age, stress, and psychopathology during pandemics (Barzilay et al., 2020; Benjamin et al., 2020; Pérez et al., 2020; Terry et al., 2020). Thus, these variables were also included in the analysis. The main results of the current study related to the COVID-19 outbreak can be listed as follows: (i) no differences between CT groups in the gratitude trait, but differences in positive and negative affect did occur; (ii) regression models that included age, gratitude, and affect variables predicted negative and positive affects but gender did not reach the statistical level; (iii) two moderation models predicted affect from gratitude, with the CT variable moderating this effect; this moderation effect was also statistically significant in predicting negative affect but it was not statistically significant in predicting positive affect.

The CT variable has been useful to divide the sample into two different groups to address differences in terms of their positive and negative affect, also showing a congruence between measures. In addition, this measure has allowed us to differentiate the counterfactual upward and downward processes, which have also been related to the affects in the direction found in previous literature. In other words, the counterfactual upward process seems to lead to greater negative symptomatology (Broomhall et al., 2017) and the counterfactual

TABLE 1 | Descriptive statistics on the variables under study using an independent *t*-test across the CT group.

	Group	Mean	SD	<i>p</i>	Gratitude	Negative affect	Positive affect
Gratitude	Worse	27.82	5.66	0.14	–		
	Equal or better	28.84	6.26				
Negative affect	Worse	23.24	7.86	<0.001 (<i>d</i> ' = 0.94)	–0.357*	–	
	Equal or better	15.94	7.49				
Positive affect	Worse	31.80	8.25	<0.001 (<i>d</i> ' = –0.57)	0.536*	–0.459*	–
	Equal or better	36.24	7.18				

Pearson's correlation coefficients are displayed across the variables of interest. **p* < 0.05.

TABLE 2 | Linear regression coefficients on the prediction of gratitude scores.

Model		B	SE	β	<i>t</i>	<i>p</i>
Negative affect	(Intercept)	43.526	2.499		17.416	0.000
	Age	–0.124	0.025	–0.232	–5.046	0.000
	Gender	0.541	0.787	0.032	0.688	0.492
	Gratitude	–0.228	0.078	–0.161	–2.922	0.004
	CT group	–5.352	0.815	–0.315	–6.567	0.000
	Positive affect	–0.293	0.060	–0.279	–4.924	0.000
Positive affect	(Intercept)	25.152	3.007		8.364	0.000
	Age	–0.050	0.024	–0.098	–2.091	0.037
	Gender	–1.157	0.737	–0.072	–1.570	0.117
	Gratitude	0.599	0.066	0.444	9.121	0.000
	CT group	2.002	0.812	0.124	2.466	0.014
	Negative affect	–0.259	0.053	–0.272	–4.924	0.000

downward process to greater wellbeing (e.g., Nicuța and Constantine, 2021). However, this variable did not allow us to find differences in the trait of gratitude suggesting that having high or low levels of gratitude is independent of comparative thinking (where participants indicate that they were worse or, conversely, that they were equal or better). Perhaps having the trait of gratitude does not influence comparative thinking regarding the effects of a pandemic. One should bear in mind that this measurement is a global judgment that does not consider other processes that are involved in the assessment of emotional state. The fact of making a global judgment in relation to CT has implications in the participant's categorization in relation to gratitude and affect (Bernabe-Valero et al., 2021). In this way, it was found that participants with poorer affect were more biased when making such global judgments, even when reporting similar values in gratitude. Another possible explanation is related to the conceptualization of the trait of gratitude, since the definition of this construct is rather complex. In this research, a unidimensional measure was chosen to make the questionnaires easier for participants but several studies have found differences in results depending whether a unidimensional or multidimensional measure of gratitude has been used (e.g., Martinez-Cortés and Bernabe-Valero, 2018; Bernabé-Valero et al., 2019). Future research should address different gratitude conceptions in its nature (Bernabe-Valero et al., 2020) as well as in its cultural conception (Robustelli and Whisman, 2018). On the other hand, gratitude has been shown to

be directly related to positive affect and inversely related to negative affect, as previous literature has shown, particularly in times of a pandemic (Burke et al., 2020; Jiang, 2020) as well as other historical moments (Watkins et al., 2006; Frias et al., 2011). This might indicate that more grateful people may enjoy better affectivity by experiencing higher levels of positive affect and lower levels of negative affect.

Furthermore, these aforementioned variables (CT, gratitude, and affect) plus the age variable, were able to predict negative and also positive affect through two regression models. In relation to age, the general consensus is that older people exhibit a feeling of greater wellbeing and less negative affectivity (e.g., Pinquart, 2001; Ebert et al., 2020). This is congruent with our results which indicate that older people have lower values of negative affectivity. Although the relationship between age and positive affect was statistically significant in the regression model, the value of the slope is very low and therefore not informative. Thus, it can be concluded that negative affect seems to decrease with age which has been considered a compensatory strategy to deal with life losses (Charles et al., 2001; Carstensen et al., 2011; Moreno-Cid et al., 2015). Self-efficacy is also a variable of interest for future lines of research, as it has been described to influence positive and negative affect (Bandura et al., 2003). Even if this is not directly considered in the current scope of research, further research in this field might shed light on this triad.

On the other hand, gender did not predict positive and negative affect, which supports the claim of no differences

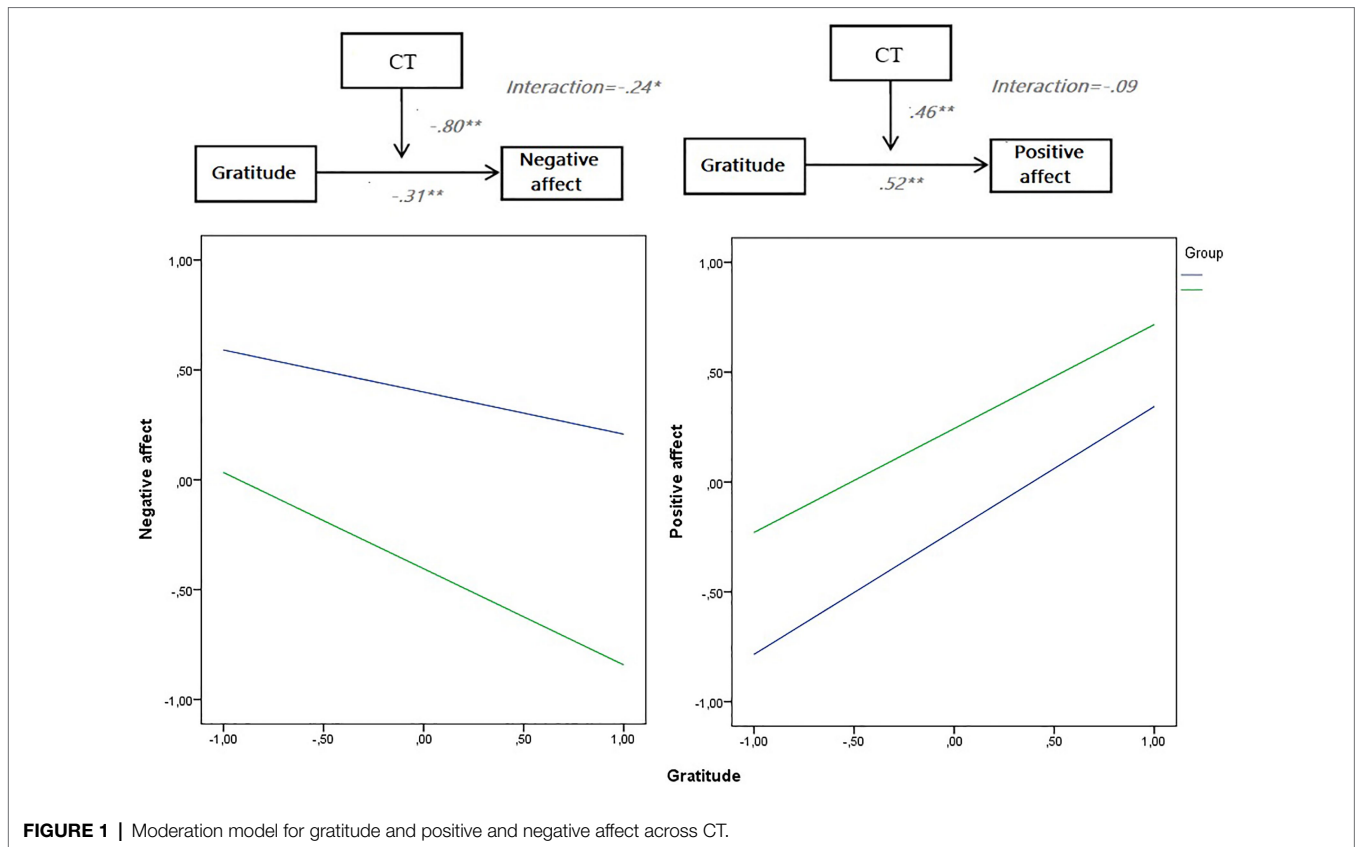


FIGURE 1 | Moderation model for gratitude and positive and negative affect across CT.

TABLE 3 | Conditional effect of X on Y at values of the moderator.

Group measures	Effect	SE	t	p	LLCI	ULCI
CT groups	-0.19	0.08	-2.33	<0.05	-0.35	-0.02
	-0.43	0.08	-5.39	<0.001	-0.59	-0.27

Effects, standard error (SE), statistical significance, and lower and upper (LLCI and ULCI) level.

between men and women in terms of COVID-19 affect in the previous literature (Cao et al., 2020; Zhang and Ma, 2020) but not those studies that claimed that women are more negatively affected (Rogowska et al., 2020; Wang et al., 2020). This inconsistency in results alerts us to the need to delve deeper into the processes underlying differences in affective regulation between men and women in order to robustly conclude their affect in the current crisis. Note that this process can be very complex, involving socio-demographic and cultural variables.

As expected, the predictive relationship of gratitude for positive and negative affect has been confirmed. Of interest, the moderation effect occurred for negative affect exclusively. This means that gratitude inversely predicted negative affect experienced in the pandemic, and furthermore, this relationship was moderated by CT, also indicating that this effect was different for participants who used a counterfactual downward process than for those who used a counterfactual upward process.

However, gratitude directly predicted positive affect, and this effect was homogeneous for the two groups. Thus, for those participants who indicated that they were *worse*, the protective effect of gratitude on the decrease in negative affectivity decreased, i.e., these effects were moderated; whereas this moderation was less for those who indicated that they were *equal* or *better*.

One mechanism that could explain the gratitude predictive relationship in decreasing negative affect is provided by the broaden-and-build theory (Fredrickson, 2001), which posits that positive emotion experiences broaden people’s momentary thought-action repertoires. In other words, individuals who are more grateful, and, therefore experience higher levels of gratitude in everyday life (McCullough et al., 2004), might broaden their thought-action repertoires due to the positive valence of gratitude. In this way, they may create different thinking and action options in threatening situations. Thereby, emotional management could be improved and negative emotions could be decreased (e.g., scared and nervous emotions as assessed by the positive and negative affect schedule). This mechanism could act in a variety of daily situations and routines, leading to a decrease in negative affect. However, in relation to CT, this comparative thinking is the result of objective conditions derived from the pandemic (e.g., people might have suffered losses in the frequency and quality of social relationships, economic losses, close deaths due to COVID-19, among others), and also have attributed negative meanings to these losses or experienced fears due to the global situation of uncertainty,

contributing subjective elements to this judgment. In addition to this, participants engaged in comparative thinking, also bringing into play the counterfactual thinking processes discussed above. We consider that those individuals who in CT indicated that they were “worse” are reflecting the malaise associated with the events that occurred in the pandemic. This malaise would be moderating the beneficial effects of gratitude on negative affect. Thus, the emotion of gratitude would compete with other negative emotions included in their malaise (e.g., for losses during the pandemic). Thus, interfering with the mechanism of amplification of positive emotions, and the beneficial effect of gratitude in decreasing negative affect would be minimized. Conversely, those participants with high levels of CT (equal or better) would be reflecting on the fact that they are not experiencing higher levels of distress than before the pandemic, and, in their case, their dispositional trait of gratitude would be effective in decreasing levels of negative affect, obtaining similar results to studies conducted in non-pandemic times (e.g., for a meta-analysis of the beneficial effects of gratitude on wellbeing, see Portocarrero et al., 2020).

In addition, we consider that the CT could act as an affective schema by integrating experiences and influencing affectivity. Moreover, it has been suggested that the psychological dynamics of gratitude involve a flexible and integrated view for positive and negative aspects of an experience, complemented in a final consideration that privileges a caring and protective global view (Moyano, 2011). In this way, for those participants who considered a more positive general approach with high levels of CT, the moderating effect on affectivity was less accentuated and vice-versa for participants with low levels. However, CT did not have a moderating effect between gratitude and positive affect, indicating that grateful people (regardless of their CT score) will have higher levels of positive affect and less grateful people will have lower levels of positive affect. Unlike the previous moderation model, CT-associated malaise (e.g., worse) does not diminish the predictive relationship of gratitude with positive affect, also revealing that positive emotions are more robustly related to each other than positive emotions (e.g., daily gratitude) and negative affect, as this relationship may be moderated by other variables such as CT. This result seems to reinforce the idea of distinct underlying patterns for positive and negative affect (i.e., Fredrickson and Joiner, 2002).

An additional aspect to consider is the instrument employed for the assessment of gratitude based on a unidimensional scale in the current study, which has not allowed us to assess aspects as interesting as gratitude in terms of suffering, but are included in other scales underlying the term of gratitude (e.g., the G20 in Bernabé-Valero et al., 2014; English adaptation in Bernabe-Valero et al., 2020). In other words, this seems particularly suitable for assessing whether people can feel gratitude in situations that generate suffering, such as the ongoing crisis resulting from the current pandemic. We suggest that the inclusion of this scale in a predictive model could have promising results in the moderating effect of CT between gratitude and affectivity, using longitudinal designs that might capture the experience of gratitude in adverse situations once these have ended.

Definitely, these models might not only help to clarify the relationships between dispositional traits and affect, in line with other studies in the field (McCullough et al., 2004; Wood et al., 2008), but could also include comparative thinking variables from the cognitive domain, showing that these variables can modify these relationships. In this way, the relevance of multivariate models that include different affective, cognitive, and dispositional dimensions is emphasized.

The current research has also explored the prediction of negative and positive affect in times of COVID, based on different dispositional, demographic, and cognitive variables. In addition, these results contribute to provide more evidence on the importance of gratitude as a human strength that promotes benefits in psychological health. Taken into consideration that individuals with higher scores in negative affect tend to have a higher incidence of depressive symptoms compared to the general population (Roberts and Kassel, 1996), these results may have therapeutic and educational implications for health programs. These might be of interest for the improvement of the affective experience, especially in times such as the COVID-19 pandemic. In light of the results obtained, we consider that they might provide clues that go beyond this adverse situation to come across different basic psychological needs and processes that explain human behavior.

The main limitations of this study can be described as follows: (i) the sample was selected through an incidental sampling; (ii) data were collected in a self-report way; (iii) data on COVID-19 knowledge or exposure were not collected. Future lines of research should include more information on knowledge regarding COVID-19 and exposure, to better understand the role of positive and negative affect. Nevertheless, it is expected that these results are of interest at both applied and theoretical levels.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Universidad Católica de Valencia San Vicente Mártir committee (number UCV2017-2018-28). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GB-V conceived the presented idea. GB-V, CM-T, JB-M, and RA-M developed the theory and performed the computations. All authors discussed the results and contributed to the final manuscript.

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REFERENCES

- Ammar, A., Chtourou, H., Boukhris, O., Trabelsi, K., Masmoudi, L., Brach, M., et al. (2020a). COVID-19 home confinement negatively impacts social participation and life satisfaction: a worldwide multicenter study. *Int. J. Environ. Res. Public Health* 17:6237. doi: 10.3390/ijerph17176237
- Ammar, A., Mueller, P., Trabelsi, K., Chtourou, H., Boukhris, O., Masmoudi, L., et al. (2020b). Psychological consequences of COVID-19 home confinement: The ECLB-COVID19 multicenter study. *PLoS One* 15:e0240204. doi: 10.1371/journal.pone.0240204
- Assari, S., and Lankarani, M. M. (2016). Stressful life events and risk of depression 25 years later: race and gender differences. *Front. Public Health* 4:49. doi: 10.3389/fpubh.2016.00049
- Bandura, A., Caprara, G. V., Barbaranelli, C., Gerbino, M., and Pastorelli, C. (2003). Role of affective self-regulatory efficacy in diverse spheres of psychosocial functioning. *Child Dev.* 74, 769–782. doi: 10.1111/1467-8624.00567
- Barzilay, R., Moore, T. M., Greenberg, D. M., DiDomenico, G. E., Brown, L. A., White, L. K., et al. (2020). Resilience, COVID-19-related stress, anxiety and depression during the pandemic in a large population enriched for healthcare providers. *Transl. Psychiatry* 10:291. doi: 10.1038/s41398-020-00982-4
- Benjamin, A., Kuperman, Y., Eren, N., Amitai, M., Rossman, H., Shilo, S., et al. (2020). Stress-related emotional and behavioural impact following the first COVID-19 outbreak peak. *MedRxiv* [Preprint]. doi: 10.1101/2020.12.08.20245787
- Bernabe-Valero, G., Blasco-Magraner, J. S., and García-March, M. R. (2020). Gratitude questionnaire–20 items (G20): a cross-cultural, psychometric and crowdsourcing analysis. *Front. Psychol.* 11:626330. doi: 10.3389/fpsyg.2020.626330
- Bernabe-Valero, G., García-Alandete, J., and Gallego-Pérez, J. F. (2013). Análisis comparativo de dos modelos del Gratitude Questionnaire - Six Items Form. *Rev. Latinoam. Psicol.* 45, 279–288. doi: 10.14349/rlp.v45i2.811
- Bernabé-Valero, G., García-Alandete, J., and Gallego-Pérez, J. F. (2014). Construcción de un cuestionario para la evaluación de la gratitud: el Cuestionario de Gratiitud–20 ítems (G-20). *An. Psicol./Ann. Psychol.* 30, 278–286. doi: 10.6018/analesps.30.1.135511
- Bernabe-Valero, G., Melero-Fuentes, D., De Lima Argimon, I. I., and Gerbino, M. (2021). Individual differences facing the COVID-19 pandemic: the role of age, gender, personality, and positive psychology. *Front. Psychol.* 12:644286. doi: 10.3389/fpsyg.2021.644286
- Bernabé-Valero, G., Moret-Tatay, C., Iborra-Marmolejo, I., and Blasco-Magraner, J. S. (2019). Psychometric properties of the indebtedness scale (IS-R) in Spanish university students. *Front. Psychol.* 10:1094. doi: 10.3389/fpsyg.2019.01094
- Bono, G., Reil, K., and Hescoc, J. (2020). Stress and wellbeing in urban college students in the US during the COVID-19 pandemic: can grit and gratitude help? *Int. J. Wellbeing* 10, 39–57. doi: 10.5502/ijw.v10i3.1331
- Broomhall, A. G., Phillips, W. J., Hine, D. W., and Loi, N. M. (2017). Upward counterfactual thinking and depression: a meta-analysis. *Clin. Psychol. Rev.* 55, 56–73. doi: 10.1016/j.cpr.2017.04.010
- Burke, T., Berry, A., Taylor, L. K., Stafford, O., Murphy, E., Shevlin, M., et al. (2020). Increased psychological distress during COVID-19 and quarantine in Ireland: a national survey. *J. Clin. Med.* 9:3481. doi: 10.3390/jcm9113481
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287:112934. doi: 10.1016/j.psychres.2020.112934
- Carstensen, L. L., Turan, B., Scheibe, S., Ram, N., Ersner-Hershfield, H., Samanez-Larkin, G. R., et al. (2011). Emotional experience improves with age: evidence based on over 10 years of experience sampling. *Psychol. Aging* 26, 21–33. doi: 10.1037/a0021285
- Charles, S. T., Reynolds, C. A., and Gatz, M. (2001). Age-related differences and change in positive and negative affect over 23 years. *J. Pers. Soc. Psychol.* 80, 136–151. doi: 10.1037/0022-3514.80.1.136
- Chen, L. H., Chen, M.-Y., Kee, Y. H., and Tsai, Y.-M. (2008). Validation of the gratitude questionnaire (GQ) in Taiwanese undergraduate students. *J. Happiness Stud.* 10:655. doi: 10.1007/s10902-008-9112-7
- Duan, L., and Zhu, G. (2020). Psychological interventions for people affected by the COVID-19 epidemic. *Lancet Psychiatry* 7, 300–302. doi: 10.1016/S2215-0366(20)30073-0
- Ebert, A. R., Bernstein, L. E., Carney, A. K., and Patrick, J. H. (2020). Emotional well-being during the first four months of COVID-19 in the United States. *J. Adult Dev.* 27, 241–248. doi: 10.1007/s10804-020-09365-x
- Emmons, R. A., Froh, J., and Rose, R. (2019). “Gratitude,” in *Positive Psychological Assessment: A Handbook of Models and Measures*. eds. M. W. Gallagher and S. J. Lopez (Washington, DC: American Psychological Association), 317–332.
- Emmons, R. A., and Mishra, A. (2011). “Why gratitude enhances well-being: what we know, what we need to know,” in *Designing Positive Psychology: Taking Stock and Moving Forward*. eds. K. M. Sheldon, T. B. Kashdan and M. F. Steger (New York, NY: Oxford University Press), 248–262.
- Epstude, K., and Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personal. Soc. Psychol. Rev.* 12, 168–192. doi: 10.1177/1088868308316091
- Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: the broaden-and-build theory of positive emotions. *Am. Psychol.* 56, 218–226. doi: 10.1037/0003-066X.56.3.218
- Fredrickson, B. L., and Joiner, T. (2002). Positive emotions trigger upward spirals toward emotional well-being. *Psychol. Sci.* 13, 172–175. doi: 10.1111/1467-9280.00431
- Frias, A., Watkins, P. C., Webber, A. C., and Froh, J. J. (2011). Death and gratitude: death reflection enhances gratitude. *J. Posit. Psychol.* 6, 154–162. doi: 10.1080/17439760.2011.558848
- Huang, Y., and Zhao, N. (2020). Chinese mental health burden during the COVID-19 pandemic. *Asian J. Psychiatr.* 51:102052. doi: 10.1016/j.ajp.2020.102052
- Hudeček, M., Blabst, N., Morgan, B., and Lerner, E. (2020). Measuring gratitude in Germany: validation study of the German versions of the gratitude questionnaire-six item form (GQ-6-G) and the multi-component gratitude measure (MCGM-G). *Front. Psychol.* 11:590108. doi: 10.3389/fpsyg.2020.590108
- Jahan, N. (2020). A case for ‘counterfactual’ thinking in policymaking. *The Daily Star*. Available at: [http://dspace.bracu.ac.bd/xmlui/bitstream/handle/10361/13919/The%20Daily%20Star%20\(30.07.2020\).pdf?sequence=1](http://dspace.bracu.ac.bd/xmlui/bitstream/handle/10361/13919/The%20Daily%20Star%20(30.07.2020).pdf?sequence=1) (Accessed April 21, 2021).
- Jiang, D. (2020). Feeling gratitude is associated with better well-being across the life span: a daily diary study during the COVID-19 outbreak. *J. Gerontol. Ser. B.* doi: 10.1093/geronb/gbaa220 [Epub ahead of print].
- Kuper, N., Modersitzki, N., Phan, L. V., and Rauthmann, J. (2021). The situation during the COVID-19 pandemic: A snapshot in Germany. *PLoS One* 16:e0245719. doi: 10.1371/journal.pone.0245719
- Linley, P. y Joseph, S. (2004). Positive change following trauma and adversity: a review. *J. Trauma. Stress.* 17, 11–21. doi:10.1023/B:JOTS.0000014671.27856.7e
- MacKinnon, D. P., and Fairchild, A. J. (2009). Current directions in mediation analysis. *Curr. Dir. Psychol. Sci.* 18, 16–20. doi: 10.1111/j.1467-8721.2009.01598.x
- Martínez-Cortés, J. V., and Bernabe-Valero, G. (2018). “Gratitud y valores: un estudio correlacional con estudiantes universitarios,” in *IV Jornadas de Investigación de la Facultad de Psicología de la Universidad Católica de Valencia “San Vicente Mártir,”* 4 April, 2018.
- McCullough, M. E., Emmons, R. A., and Tsang, J. A. (2002). The grateful disposition: a conceptual and empirical topography. *J. Pers. Soc. Psychol.* 82, 112–127. doi: 10.1037/0022-3514.82.1.112

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- McCullough, M. E., Tsang, J. A., and Emmons, R. A. (2004). Gratitude in intermediate affective terrain: links of grateful moods to individual differences and daily emotional experience. *J. Pers. Soc. Psychol.* 86, 295–309. doi: 10.1037/0022-3514.86.2.295
- McNamara, P., Durso, R., Brown, A., and Lynch, A. (2003). Counterfactual cognitive deficit in persons with Parkinson's disease. *J. Neurol. Neurosurg. Psychiatry* 74, 1065–1070. doi: 10.1136/jnnp.74.8.1065
- Moreno-Cid, A., Moret-Tatay, C., Irigaray, T. Q., Argimon, I. I., Murphy, M., Szczerbinski, M., et al. (2015). The role of age and emotional valence in word recognition: an ex-Gaussian analysis. *Stud. Psychol.* 57, 83–94. doi: 10.21909/sp.2015.02.685
- Moret-Tatay, C., Lami, A., Oliveira, C. R., and Beneyto-Arrojo, M. J. (2018). The mediational role of distracting stimuli in emotional word recognition. *Psicol. Reflex. Crit.* 31:1. doi: 10.1186/s41155-017-0082-8
- Moyano, N. C. (2011). Gratitude en la Psicoterapia Cognitiva: elementos para su inclusión. *Psicodebate* 11, 9–26. doi: 10.18682/pd.v11i0.373
- Murphy, M., and Moret-Tatay, C. (2021). Personality and attitudes confronting death awareness during the COVID-19 outbreak in Italy and Spain. *Front. Psych.* 12:627018. doi: 10.3389/fpsy.2021.627018
- Mussweiler, T., and Epstude, K. (2009). Relatively fast! Efficiency advantages of comparative thinking. *J. Exp. Psychol. Gen.* 138, 1–21. doi: 10.1037/a0014374
- Nicuța, E. G., and Constantin, T. (2021). Take nothing for granted: downward social comparison and counterfactual thinking increase adolescents' state gratitude for the little things in life. *J. Happiness Stud.* 1–28. doi: 10.1007/s10902-021-00382-5
- Pérez, S., Masgoso, A., and Hernández-Espeso, N. (2020). Levels and variables associated with psychological distress during confinement due to the coronavirus pandemic in a community sample of Spanish adults. *Clin. Psychol. Psychother.* 28, 606–614. doi: 10.1002/cpp.2523
- Pérez-Mengual, N., Aragonés, I., Moret-Tatay, C., and Moliner, A. R. (2021). The relationship of fear of death between neuroticism and anxiety during the Covid-19 pandemic. *Front. Psych.* 12:648498. doi: 10.3389/fpsy.2021.648498
- Pinquart, M. (2001). Age differences in perceived positive affect, negative affect, and affect balance in middle and old age. *J. Happiness Stud.* 2, 375–405. doi: 10.1023/A:1013938001116
- Portocarrero, F. F., Gonzalez, K., and Ekema-Agbaw, M. (2020). A meta-analytic review of the relationship between dispositional gratitude and well-being. *Personal. Individ. Differ.* 164:110101. doi: 10.1016/j.paid.2020.110101
- Rash, J. A., Matsuba, M. K., and Prkachin, K. M. (2011). Gratitude and well-being: who benefits the most from a gratitude intervention? *Appl. Psychol. Health Well Being* 3, 350–369. doi: 10.1111/j.1758-0854.2011.01058.x
- Roberts, J. E., and Kassel, J. D. (1996). Mood-state dependence in cognitive vulnerability to depression: the roles of positive and negative affect. *Cogn. Ther. Res.* 20, 1–12.
- Robustelli, B. L., and Whisman, M. A. (2018). Gratitude and life satisfaction in the United States and Japan. *J. Happiness Stud.* 19, 41–55. doi: 10.1007/s10902-016-9802-5
- Roese, N. J. (1997). Counterfactual thinking. *Psychol. Bull.* 121, 133–148. doi: 10.1037/0033-2909.121.1.133
- Rogowska, A. M., Kuśniercz, C., and Bokszczanin, A. (2020). Examining anxiety, life satisfaction, general health, stress and coping styles during COVID-19 pandemic in Polish sample of university students. *Psychol. Res. Behav. Manag.* 13, 797–811. doi: 10.2147/PRBM.S266511
- Solom, R., Watkins, P. C., McCurrach, D., and Scheibe, D. (2017). Thieves of thankfulness: traits that inhibit gratitude. *J. Posit. Psychol.* 12, 120–129. doi: 10.1080/17439760.2016.1163408
- Syropoulos, S., and Markowitz, E. M. (2020). Prosocial responses to COVID-19: examining the role of gratitude, fairness and legacy motives. *Personal. Individ. Differ.* 171:110488. doi: 10.1016/j.paid.2020.110488
- Teigen, K. H. (1997). Luck, envy and gratitude: it could have been different. *Scand. J. Psychol.* 38, 313–323. doi: 10.1111/1467-9450.00041
- Terry, P. C., Parsons-Smith, R. L., and Terry, V. R. (2020). Mood responses associated with COVID-19 restrictions. *Front. Psychol.* 11:589598. doi: 10.3389/fpsyg.2020.589598
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17:1729. doi: 10.3390/ijerph17051729
- Watkins, P., Scheer, J., Ovnicek, M., and Kolts, R. (2006). The debt of gratitude: dissociating gratitude and indebtedness. *Cognit. Emot.* 20, 217–241. doi: 10.1080/02699930500172291
- Watson, D., Clark, L. A., and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *J. Pers. Soc. Psychol.* 54:1063. doi: 10.1037/0022-3514.54.6.1063
- Wood, A. M., Maltby, J., Stewart, N., Linley, P. A., and Joseph, S. (2008). A social-cognitive model of trait and state levels of gratitude. *Emotion* 8, 281–290. doi: 10.1037/1528-3542.8.2.281
- Zgueb, Y., Bourgou, S., Neffeti, A., Amamou, B., Masmoudi, J., Chebbi, H., et al. (2020). Psychological crisis intervention response to the COVID 19 pandemic: A Tunisian centralised Protocol. *Psychiatry Res.* 289:113042. doi: 10.1016/j.psychres.2020.113042
- Zhang, Y., and Ma, Z. F. (2020). Impact of the COVID-19 pandemic on mental health and quality of life among local residents in Liaoning Province, China: a cross-sectional study. *Int. J. Environ. Res. Public Health* 17:2381. doi: 10.3390/ijerph17072381

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Mental Health in Affectionate, Antagonistic, and Ambivalent Relationships During the COVID-19 Pandemic: A Latent Profile Analysis

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The ongoing coronavirus disease-2019 (COVID-19) pandemic presents an acute stressor affecting mental health. In these stressful times, intimate relationships functioning could serve as a protective or a risk factor to the well-being of partners. Adult Croatian citizens engaged in intimate relationships ($N = 727$) reported their relationship characteristics and assessed symptoms of depression, anxiety, and stress during the state lockdown in May 2020. Three relationship profiles based on variations in key relationship characteristics were identified using latent profile analysis. Profiles represented distinct relationship types described as affectionate, ambivalent, and antagonistic relationships. These relationship types differed in their levels of love and perception of humility, responsiveness, and behavior of the partner. Relationship type was associated with mental health symptoms such as depression, anxiety, and stress during the COVID-19 pandemic and state lockdown. Being in an affectionate relationship was associated with the lowest levels of depression, anxiety, and stress, while in an antagonistic relationship these are in the highest levels. Ambivalent relationships were characterized by moderate levels on all measured mental health indicators with no difference in anxiety compared with affectionate relationships. The results emphasized the link between relationship functioning and successful coping with mental health hazards such as the fear of disease or restrictive measures put in place to contain the COVID-19 pandemic.

Keywords: COVID-19 pandemic, intimate relationships types, latent profile analysis, adult Croatian citizens, stress, depression, anxiety, dyadic coping

INTRODUCTION

The coronavirus disease-2019 (COVID-19) has affected the lives of many people in numerous and complex ways ever since its rapid spread throughout the world beginning in January 2020. Official data report shows that at his very moment there are 55,624,562 people affected by the SARS-Cov-2 virus, 35,800,000 people are cured, and 1,338,100 people have died (JHU CSSE, 2020). The pandemic has brought numerous changes in our way of living along with being a severe danger for the health of the people. Many countries took preventive measures in order to protect the lives of the people through closing schools and kindergartens, as well as bars, restaurants, and shopping malls. The culture and entertainment events were canceled, commuting was restricted, and people were

asked to work from home, stay inside, and keep physical distance from other people (European Centre for Disease Prevention Control, 2021). This “lockdown” contributed to the deteriorating mental health of many people as much as it was perceived necessary and the only possible solution at the time.

In China, moderate and severe symptoms of anxiety, stress, and depression were found among the citizens as the disease started to threaten their health and lives. (Huang and Zhao, 2020). Comparable results were reported from Hong Kong where a quarter of surveyed participants declared impaired mental health with higher levels of depression and anxiety due to the COVID-19 pandemic (Choi et al., 2020). In the study of Ettman et al. (2020), they found that the adults from the United States of America (USA) showed a three-fold higher prevalence of depression symptoms during the pandemic than before. The COVID-19 pandemic brought numerous physical and mental health risks, which have been shown to result in moderate to severe depression, anxiety, and traumatic stress-related difficulties in the general population (Wang C. et al., 2020). Additionally, measures that governments undertook all over the world to prevent the spread of COVID-19 have both short- and long-term negative impacts on mental health and well-being (Brooks et al., 2020). Finally, the negative social and economic consequences of these measures are expected to be additional risk factors for mental health which may persist for a long time after the pandemic is over (Vukčević Marković et al., 2020).

Since the very beginning of the COVID-19 pandemic and the government-imposed state “lockdown,” Croatian couples started to worry about the negative impact of being “locked-in” together for a long and indefinite time on their relationship; they were also worried about the well-being of each partner. The fear of detrimental consequences of this forced togetherness and the lack of autonomy on close relationships was evident both in comics and jokes shared via social networks, as well as in serious articles and talk shows in the media. Partners being together 24/7 was thought to be a severe cause of stress and as a risk factor for personal well-being during the COVID-19 pandemic.

The need to belong is a fundamental human motive nonetheless; meaningful and enduring social relationships are essential to health and well-being (Baumeister and Leary, 1995; Slavich, 2020). Social connectedness impacts physical and mental health as shown in many studies (Holt-Lunstad et al., 2015). Research in the field of intimate relationships shows that married people tend to experience better physical and mental health, and lower mortality than single or divorced people (Amato, 2000; Frisch and Simonsen, 2013; Zissimopoulos et al., 2013). The quality of the relationship between partners was identified as a crucial factor in these associations. Whether a couple is married or not, managing a satisfying relationship promotes their personal and professional functioning, enhances their physical and mental health, and helps the development of their children (Cummings and Davies, 2002; Whisman and Uebelacker, 2006).

People need each other even more and rely on significant others to provide social support in times of stress and crisis, such as during this pandemic (Haslam and Reicher, 2006; Taylor, 2006). However, according to the vulnerability-stress-adaptation

model (Karney and Bradbury, 1995), perceived stress lowers the capacity of a partner for constructive and adaptive reactions within the relationship (Baumeister, 2014; Neff and Karney, 2017); it also enhances the probability of maladaptive reactions (Neff and Karney, 2009). In turn, these hostile behaviors, negative communication, or even physical violence raise the level of experienced stress (Story and Bradbury, 2004; Bodenmann, 2005; Langer et al., 2008). For example, couples who reported elevated levels of perceived stress were less inclined to constructive problem-solving, which backfires on their level of perceived stress (Woszidlo and Segrin, 2013).

The study of Karney and Gauer (2010) suggests that in satisfying and stabilizing relationships, partners should be able to see things from the perspective of each other and avoid making maladaptive attributions for the behavior of each other. Recent evaluations of the construct humility show its value for maintaining quality, stability, and satisfaction in intimate relationships (Exline and Geyer, 2004). Interpersonal humility consists of modest self-presentation and an orientation toward others, which contribute to higher quality close relationships and better conflict resolutions (Wright et al., 2017). Humility is a positive affective state (Weidman et al., 2018) that includes prosocial and affiliative emotions and promotes understanding, forgiveness, and gratitude (Worthington et al., 2016). Individuals who perceive their partners as humble are more satisfied (Dwiwardani et al., 2018) and invest more in their relationships (Worthington et al., 2016). They also experience lower levels of stress (Ripley et al., 2016). Along with perceiving partners as humble, it is also beneficial for the relationship to perceive the partner as responsive to the needs of the other (Reis et al., 2004). Perceived responsiveness of the partner assumes a feeling of understanding, support, and respect of the other partner and contributes to more intimacy and satisfaction in a relationship (Reis and Shaver, 1988; Reis, 2017). It also promotes the well-being of partners, life satisfaction, and other positive effects (Gable et al., 2012; Otto et al., 2015).

These individual characteristics influence the way partners behave with each other and also shape their relationship (Kelley, 1979; Marshall et al., 2011). Behaviors have a huge role in affecting the quality of a relationship (Neff and Karney, 2009). In other words, the satisfaction of partners is reflected in the way they treat each other; in turn, it defines their satisfaction with their relationship, thus creating an interdependent system (Huston and Vangelisti, 1991; Neff and Karney, 2009). The studies of Caughlin and Huston (2006), as well as Vangelisti and Huston (1994), emphasized the importance of the interaction of partners with each other when identifying key domains of relationship satisfaction. Relationships can be described in terms of recurring behavioral processes that take place during an interaction between two partners, i.e., how often spouses criticize each other, how much they disclose, and how consistently they validate each other. Marital satisfaction, and warm or hostile behaviors of both partners start resembling each other as the time of the relationship progresses. All relevant theories in the field of intimate relationships assume such a cyclical relationship between behavior and relationship satisfaction and thus confirm the importance of specific behaviors as determinants of marital

satisfaction. The *emotional climate* of a relationship reflects two core constructs: affection and antagonism. Combinations of the affectionate and antagonistic behaviors of partners in their everyday life differentiate relationships from one another (Caughlin and Huston, 2006). Affection and antagonism seem to be the two distinct dimensions, as confirmed by factor analyses and a low correlation between the two dimensions/factors (Smith et al., 1990; Huston and Vangelisti, 1991; Gable et al., 2003). In other words, lack of antagonism in a marriage still does not make it affectionate and happy, just as a lack of loving behaviors does not necessarily make it hostile. Affectionate and antagonistic behaviors often interact, and antagonistic behaviors can be interpreted differently depending on the level of affection they are embedded in Gottman (1994), Huston and Chorost (1994), Caughlin and Huston (2002), and Jelić et al. (2014). Therefore, the study of Caughlin and Huston (2006) suggests four archetypal emotional climates defined by the affection and antagonism dimensions: (1) high affection and low antagonism indicate *warm* marital climate, (2) high affection and high antagonism are typical of *tempestuous or stormy* emotional climate, (3) low affection and high antagonism represent *hostile* emotional climate in marriage, and (4) low affection and low antagonism characterize *bland* marriages. Marriages that fall somewhere between bland and tempestuous marriages are named *mixed blessings* in terms of emotional climate; it has an equal ratio of positive and negative elements.

Quality of interactions and communication between partners is sensitive to stress (Cutrona et al., 2003; Neff and Karney, 2004) and shows drastic decline even in experimental conditions (Bodenmann and Shantinath, 2004). External stressors and stressors within a relationship affect the quality of a relationship through the communication patterns between partners (Ledermann and Macho, 2009; Ledermann et al., 2010). Relational self-efficacy could be a protective factor in this process; individuals with higher relational self-efficacy are more prone to resolve conflicts through constructive communication in situations of perceived high levels of stress (Huić et al., 2016).

The traditional individual approach to stress and coping was challenged by many theorists at the beginning of the 1990s (Bodenmann et al., 2016). The systemic-transactional model (Bodenmann, 1995) being among the first model which suggested that perceived stress and coping are social processes embedded in close relationships. The model includes a focus on coping as a genuine dyadic phenomenon processed on the dyadic level. This dyadic level processing means that the stress signals of one partner and the coping reactions to these verbal and nonverbal signals of the other partner are taken into mutual consideration. In dependence upon the stress event, the stress management resources of both partners are activated in dyadic coping (DC) to maintain or restore a state of dyadic homeostasis (Bodenmann, 2005). Although people could cope with stress individually or with support from others, the quality of intimate relationships is affected through the reaction of one partner to the stress of the other partner as well as through joint DC in situations of mutual stressors such as the COVID-19 pandemic. Dyadic coping proved to be a predictor of relationship outcomes such as marital satisfaction and stability, quality of marriage, etc., as shown in

the studies of Bodenmann and Cina (2006), Bodenmann et al. (2006), and Ledermann et al. (2010). The study of Bodenmann and Cina (2006) concluded that DC may significantly contribute to a strong feeling of “we-ness” within the couple by creating a cognitive internal working model of the relationship as being a helpful, supportive, enriching, and reliable resource.

CURRENT STUDY

The purpose of this study is to explore how different levels of key relationship variables: love, partner perception, partner's antagonistic and affectionate behavior, and DC form different relationship profiles. The study also aims to examine the association between different relationship profiles and mental health indices related to the COVID-19 pandemic: symptoms of depression, anxiety, and stress. Thus, the following research questions guided the study: What are the patterns of relationship characteristics? How many relationship profiles based on individual differences on key relationship variables can be distinguished using latent profile analysis (LPA)? Are these relationship profiles discriminately associated with depression, anxiety, and stress during the COVID-19 pandemic and the state lockdown?

Consistent with the exploratory nature of this study, we postulated no a priori hypotheses regarding the number of emerging profiles. Consequently, we did not formulate specific conjectures about the associations between specific profiles and mental health indices. However, we did presume more than one profile would emerge and expected participants in better functioning intimate relationships would show lower levels of depression, anxiety, and stress.

MATERIALS AND METHODS

Participants and Procedures

Data were collected from May to June 2020 in Croatia as part of a larger *How are we?—Life in Croatia in time of the Corona pandemic* study focusing on the effects of the COVID-19 pandemic in Croatia, as well as a strong earthquake taking place in the Zagreb area in March 2020. Participants were recruited through newspapers, online portals, University mailing lists, word of mouth, and using the snowball recruitment method. The large study goal was to inquire about the changes in way of living, parenting, relationships, work, school, and stress levels caused by the newfound situation and to investigate the coping mechanisms of all generations. This was done through an online survey on the SoSciSurvey platform and with a specific questionnaire structure consisting of 10 separate but compatible branches. After having answered the questions in the common branch, participants could choose in which order they would like to access other branches. Only relevant branches were displayed based on the sociodemographic characteristics of the respondents.

Among the 4,029 persons who took the survey, 157 (3.9%) were excluded because they provided answers only for the sociodemographic questions. Out of the remaining 3,872 participants, 2,366 (70.7%) were in a relationship and 792 (33.5%) proceeded to complete the part of the questionnaire about

relationship characteristics. Included in the 792 participants who took part in the intimate relationships branch, 727 (91.8%) provided answers to 50% or more of the questions. Thus, the analytical sample included 727 partnered individuals ($M_{\text{age}} = 36.37$, $SD = 12.89$, range 18–95 years; 85% of women). A multivariable logistic regression analysis was carried out with a binary outcome of having chosen to participate in the intimate relationship branch or not to address possible self-selection biases. Independent variables were age, gender, having children, and the level of completed formal education. Younger participants ($AOR = 0.98$, $p < 0.001$), with a higher level of completed formal education ($AOR = 1.17$, $p = 0.001$) and with children ($AOR = 2.22$, $p < 0.001$) had higher odds of taking part in the intimate relationship branch. Additionally, to address the possible biases introduced by excluding participants who answered less than half of all intimate relationship questions, another multivariable logistic regression was conducted with the binary outcome of having completed $\geq 50\%$ of the branch items vs. having completed $< 50\%$ of branch items. Independent variables were age, gender, having children, and the level of completed formal education. Participants had equally high odds of responding to at least half of the intimate relationship questions. The median time to complete the relationship branch of the questionnaire was 10–15 min.

Sample characteristics are shown in **Table 1**.

More than three-quarters of all participants were women (85.1%). Women were somewhat younger ($M = 35.37$, $SD = 12.42$) than men ($M = 42.18$, $SD = 14.05$). The sample was heterogeneous regarding the education of the participants, with most participants having completed at least a bachelor's or a master's degree. Slightly over a half of the sample was employed (57%), almost one-third was still studying (28.9%) and the rest were unemployed (6.7%), retired (3.4%), or on parental leave (2.2%). Half of all participants reported being married (48.6%) and having children (45.1%). Approximately two-thirds were cohabiting with their partner at the time of the survey (66.2%) and living without children younger than 18 in their household (65.6%). The average relationship duration was 10 years ($SD = 10.68$, range 2 months–50 years). Only 4.8% of respondents reported being in a same-sex relationship.

Measures

Sociodemographic indicators were gender, age, level of completed formal education, employment status, type of partnership/marriage (opposite-sex/same-sex), cohabiting, being married, having own children, and the number of children in the household. None of the sociodemographic indicators were used in further analyses aside from depicting the sample.

Mental health was measured with the 21-item Depression Anxiety Stress Scale (DASS; Lovibond and Lovibond, 1995), a set of three self-report scales designed to measure the emotional states of depression, anxiety, and stress. Answers were recorded on a 4-point scale ranging from 0 = “did not apply to me at all” to 3 = “applied to me very much or most of the time.” Items include statements such as “I felt that I had nothing to look forward to” or “I was worried about situations in which I might panic and make a fool of myself.” Sum scores for each subscale

TABLE 1 | Sociodemographic characteristics of the sample.

	<i>n</i> (%) ^a
Gender	
Women	618 (85.1%)
Men	108 (14.9%)
Cohabiting with the partner	
Yes	481 (66.2%)
No	246 (33.8%)
Marital status	
Married	353 (48.6%)
Not married	373 (51.3%)
Having own children	
Yes	328 (45.1%)
No	399 (54.9%)
Number of children younger than 18 living in the household	
0	477 (65.6%)
1	99 (13.6%)
2	110 (15.1%)
3	35 (4.8%)
4 or more	6 (0.8%)
Type of relationship/marriage	
Heterosexual	692 (95.2%)
Homosexual	35 (4.8%)
Finished level of formal education	
Primary school	7 (1%)
High school	179 (24.6%)
College or Undergraduate	153 (21%)
Graduate (Master's Degree)	288 (39.6%)
Specialization, PhD	100 (13.8%)
Employment status	
Student	210 (28.9%)
Employed	414 (57%)
Unemployed	49 (6.7%)
Retired	25 (3.4%)
Parental leave	16 (2.2%)
Other	13 (2.8%)
	<i>M</i> (<i>SD</i>) in years
Age	36.37 (12.89)
Relationship duration	10.04 (10.68)

^aPercentages do not always add up to 100 due to rounding up.

were computed by adding up the scores on all items per subscale and multiplying them by 2 with higher scale scores indicating more depressive, anxious, and stress symptoms, respectively. Internal consistency of each subscale was acceptable (Cronbach's $\alpha_{\text{depression}} = 0.92$, $\alpha_{\text{anxiety}} = 0.90$ and $\alpha_{\text{stress}} = 0.93$). These subscales offer categorization of symptoms based on score range as follows: *normal functioning* ranging from 0 through 9; *mild symptoms* ranging from 10 through 13; *moderate symptoms* from 14 through 20; *severe symptoms* from 21 through 27; *extreme symptoms* with values above the value of 28.

Love and intimacy were conceptualized as the extent to which one feels a sense of closeness, belonging, and attachment to their

partners corresponding with the construct of passionate love (Hatfield and Rapson, 1993). Love and intimacy were assessed using the unidimensional 9-item Love Scale, a subscale from the Relationships Questionnaire (Braiker and Kelley, 1979) with items such as “To what extent do you love your partner?” and “How close do you feel toward your partner?” The item “How sexually intimate are you with your partner?” was excluded as it pertained to sexual behavior which was assessed with a different measure not included in this paper. The answers were anchored on a 9-point scale ranging from 1 = “not at all to 9 = “extremely.” A higher score indicates greater feelings of love for and belonging to the partner. Internal consistency was at Cronbach’s $\alpha_{\text{love}} = 0.94$.

Perceived partner responsiveness, the perception of a partner to the responsiveness, understanding, and validation of the other partner to themselves (Reis and Carmichael, 2006) was measured with eight items from the 12-item Perceived Partner Responsiveness Scale (PPRS; Reis et al., 2011) on a 7-point scale from 1 = “not at all true” through 4 = “moderately true” to 7 = “completely true.” Items include the stem “My partner usually:” with statements such as “really listens to me,” “seems interested in what I am thinking and feeling,” and “understands me.” The scale had high internal consistency in the current study (Cronbach’s $\alpha = 0.96$) with a higher composite score indicating higher perceived partner responsiveness.

Perceived partner humility was measured using an 11-item Perceived Partner Humility Scale (PPHS) (Mehulić et al., 2020) with answers anchored on a 7-point scale ranging from 1 = “not at all true, through 4 = “moderately true” to 7 = “completely true.” The items include statements such as: “He/she tries to understand others’ perspective” and “Has an overly high opinion about himself/herself” The composite measure had acceptable internal consistency (Cronbach’s $\alpha = 0.78$) and was calculated as the average of the responses to all items, with a higher result indicating a higher level of perceived partner humility.

Marital climate/socio-emotional behavior in a relationship was measured using the Inventory of Affection and Antagonism in Marriage (Huston et al., 2010). The inventory measures affectionate and antagonistic partner behaviors in the past month. The affection of the partner was assessed with 8 items describing positive behaviors such as “Your partner did something nice for you that you didn’t expect” and partner’s antagonism was measured with 8 items describing their negative behaviors in a relationship such as “Your partner showed anger or impatience by yelling, snapping, or raising his/her voice at you” on a 5-point scale (1 = not once; 2 = once; 3 = two or three times; 4 = several times; 5 = regularly). Higher scores on the affection subscale indicate a higher frequency of affectionate behavior of a partner, and higher scores on the antagonism subscale indicate a higher frequency of antagonistic behavior of a partner. Internal consistency of both scales was adequate (Cronbach’s $\alpha_{\text{affection}} = 0.91$ and $\alpha_{\text{antagonism}} = 0.85$).

Dyadic coping. Dyadic coping was measured using two subscales from the Dyadic Coping Inventory (DCI; Bodenmann, 2008). The DCI assesses different forms of DC, e.g., common, supportive, negative, and delegated DC, as perceived by oneself and as perceived by their partner. The first subscale used

was the 5-item Common DC (CDC) measuring asymmetric or complementary involvement of both partners in a shared coping process expressed through talking about the stress and its meaning for each partner; jointly trying to reframe them and searching for more information, mutual efforts to calm down, or sharing emotional or physical intimacy (Bodenmann et al., 2016). The items include statements such as: “We try to cope with the problem together and search for ascertained solutions” with answers being anchored on a 5-point scale (1 = very rarely; 2 = rarely; 3 = sometimes; 4 = often; 5 = very often). The second subscale used was the 2-item Evaluation of Couple’s DC with items such as “I am satisfied with the support I receive from my partner and the way we deal with stress together” and the answers are anchored on the same 5-point scale as above. Internal consistency of both scales was adequate (Cronbach’s $\alpha_{\text{common dyadic coping}} = 0.89$ and $\alpha_{\text{evaluation}} = 0.93$) with a higher score on both indicating greater common DC and a better evaluation of a couple’s DC, respectively.

Statistical Analyses

The missing values in the analytical sample ($N = 727$) were missing completely at random [Little’s MCAR χ^2 (952) = 980.57.82, $p = 0.25$] with most key variables having < 1% of missing values except for the marital climate indicators (2–3% of missing values) and the DC indicators (5% of missing values). In the current study, to discover the number of emerging profiles of relationship functioning, we conducted an LPA, and to assess the associations between specific relationship profiles and mental health indices we conducted an analysis of variance. Additionally, using chi-square statistics we provided an insight into the prevalence of depression, anxiety, and stress categorized according to reported symptom intensity across relationship types. All statistical procedures were carried out using IBM SPSS 25 statistical software package and Mplus 8.

RESULTS

The results in **Table 2** show that participants on average felt love and closeness ($M = 7.63$, $SD = 1.45$) toward their partner perceiving their partners as responsive ($M = 5.43$, $SD = 1.4$) and humble ($M = 4.90$, $SD = 0.99$) and their behavior in the past month as more often affectionate ($M = 3.84$, $SD = 0.95$) than antagonistic ($M = 2.14$, $SD = 0.84$). In times of stress, participants reported coping with it together with their partner ($M = 3.69$, $SD = 0.96$) and evaluated their joint coping positively ($M = 3.88$, $SD = 1.09$). No gender differences were observed on any of the key indicators apart from antagonistic behavior of a partner $t_{(710)} = 2.12$, $p = 0.035$; Cohen’s $d = 0.22$). Men described the behavior of their partners in the past month as more antagonistic ($M = 2.30$, $SD = 0.90$) compared with women ($M = 2.11$, $SD = 0.83$). This overall positive evaluation of the partner and the relationships corresponds with the experience that individuals who are satisfied with their relationships tend to participate in studies assessing relationship characteristics (Karney and Bradbury, 2010).

The love of the participants for their partner was moderately associated with perceiving their partner as responsive ($r = 0.75$,

TABLE 2 | Descriptive statistics.

		<i>M</i> (<i>SD</i>)	<i>t</i>
Love Scale	Men	7.60 (1.58)	−0.21
	Women	7.64 (1.43)	
	Total	7.63 (1.45)	
Perceived partner humility	Men	5.86 (0.87)	−0.42
	Women	4.90 (1.01)	
	Total	4.90 (0.99)	
Perceived partner responsiveness	Men	5.50 (1.34)	0.51
	Women	5.42 (1.42)	
	Total	5.43 (1.40)	
Partner's affectionate behavior	Men	3.80 (1.10)	−0.41
	Women	4.85 (0.92)	
	Total	3.84 (0.95)	
Partner's antagonistic behavior	Men	2.30 (0.90)	2.12*
	Women	2.11 (0.83)	
	Total	2.14 (0.84)	
Common dyadic coping	Men	3.65 (1.05)	−0.43
	Women	3.70 (0.95)	
	Total	3.69 (0.96)	
Evaluation of dyadic coping	Men	3.92 (1.12)	0.39
	Women	3.88 (1.08)	
	Total	3.88 (1.09)	
Depression	Men	8.20 (10.50)	−2.56*
	Women	10.98 (10.38)	
	Total	10.59 (10.45)	
Anxiety	Men	4.41 (6.92)	−4.59***
	Women	7.93 (9.44)	
	Total	7.42 (9.19)	
Stress	Men	9.83 (9.73)	−5.69***
	Women	16.28 (11.05)	
	Total	15.34 (11.11)	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

$p < 0.001$) and humble ($r = 0.54$, $p < 0.001$), with the link between love and perceived partner humility being somewhat stronger for women ($r = 0.57$, $p < 0.001$), compared with men ($r = 0.40$, $p < 0.001$). The responsiveness of a partner was most strongly correlated with the affectionate ($r = 0.80$, $p < 0.001$) and antagonistic ($r = -0.68$, $p < 0.001$) behavior of a partner, as well as the evaluation of successful DC ($r = 0.80$, $p < 0.001$).

Finally, over a half of all participants reported experiencing no depressive ($N = 404$; 55.8%), anxious symptoms ($N = 470$; 64.7%) and stress ($N = 390$; 53.8%). On average, participants reported low anxiety ($M = 7.42$, $SD = 9.19$), being mildly depressive ($M = 10.59$, $SD = 10.45$) and moderately stressed ($M = 15.34$, $SD = 11.11$) with significant gender differences in all three mental health domains ($t_{[721]}^{\text{depression}} = -2.56$, $p = 0.01$; $t_{[723]}^{\text{anxiety}} = -4.59$, $p < 0.001$; $t_{[722]}^{\text{stress}} = -5.69$, $p < 0.001$). Women reported more depressive ($M = 10.98$, $SD = 10.38$), anxious ($M = 7.93$, $SD = 9.44$), and stress ($M = 16.28$, $SD = 11.405$) symptoms compared with men ($M_{\text{depression}} = 8.2$, $SD = 10.5$; $M_{\text{anxiety}} = 4.41$, $SD = 6.92$; $M_{\text{stress}} = 9.83$, $SD = 9.73$).

An increase in these symptoms was negatively associated with all relational variables except antagonism which correlated mildly and positively with depression ($r = 0.22$, $p < 0.001$), anxiety ($r = 0.17$, $p < 0.001$), and stress ($r = 0.20$, $p < 0.001$). The association between the antagonistic behavior and depressive symptoms of a partner was stronger for men ($r = 0.27$, $p < 0.001$) than women ($r = 0.23$, $p < 0.001$). Similarly, the association with anxiety was also stronger for men ($r = 0.27$, $p < 0.001$) than women ($r = 0.17$, $p < 0.001$) as was the association with stress ($r_{\text{men}} = 0.34$, $p < 0.001$; $r_{\text{women}} = 0.21$, $p < 0.001$).

The empirically derived latent profiles were primarily established and then we examined associations of profiles with mental health subscales of the DASS using analysis of variance to ascertain the link between relationship functioning and the mental health of the participants.

Latent Profile Analysis (LPA)

A mixture model technique called latent profile analysis (Oberski, 2016) was performed to identify subtypes of homogeneous latent classes or subgroups within a large heterogeneous group by obtaining the probability that individuals belong to different groups based on the similarity of the patterns of responses of the participants (Hagenaars and McCutcheon, 2002). The observed variables were continuous, composite scores of the Love Scale, PPRS, Perceived Partner Humility, marital climate subscales of Antagonism and Affectivity, CDC, and the Evaluation of Dyadic Coping (EDC) to identify relationship classes.

Model fit was assessed sequentially for one- through four-class models. Indicators were unstandardized, variances were freed to vary across profiles, and maximum likelihood estimates with robust standard errors (MLR) addressed missing data. Several fit criteria were used to determine the optimal number of profiles. Akaike's information criterion (AIC), Bayesian information criterion (BIC), and the sample-size adjusted BIC (SABIC) are goodness-of-fit-measures with lower values indicating a better fitting model (Muthén and Muthén, 2012). Entropy is the accuracy in assigning individuals to profiles, ranging from 0 to 1. The closer the value of entropy to 1, the more likely it is that individuals belong to the profile group they have been assigned to. Entropy values of 0.8 or greater indicate profile classification with minimal uncertainty (Tein et al., 2013). Additionally, The Bootstrap Likelihood Ratio Test (BLRT; McLachlan, 1987) and the Lo-Mendell-Rubin LRT Test (LRT; Lo et al., 2001) compared improvement between the fit of the estimated model compared with a more parsimonious model with one less profile ($k - 1$) and helped in assessing whether additional profiles were improving fit or discrimination of the model (Ferguson et al., 2020). Significant LMR and BLRT p -values suggest the more parsimonious model (with one less profile) is rejected in favor of the estimated model. Optimal models were chosen based on goodness of fit and parsimony.

The three-profile solution was retained as the model best-fitting to the data based on large decreases in AIC, BIC, and SABIC values until the difference between the three- and four-profile solution. The entropy value was greater than 0.8 for all models. Although the BLRT for the three-profile solution was significant indicating that the four-profile solution is a better

representation compared with the three-profile solution, the LMR was not significant for the four-profile solution, supporting the more parsimonious model. The smallest class contained more than 5% of the sample, and the profiles were supported by the theory which makes it easier to justify and interpret (Ferguson and Hull, 2019). Summary of model selection indices of latent profile solutions for the total sample used to determine the optimal number of profiles is presented in **Table 3**.

Three profiles were identified representing antagonistic relationship, ambivalent relationship, and affectionate relationship types in the retained profile solution. The *M* and *SD* of variables used to create the chosen three-profile model are presented in **Table 4** and **Figure 1**.

The differences between the three latent groups are mostly due to differences in all variables of interest: love, perceived partner responsiveness, perceived partner humility, affectionate and antagonistic behavior of a partner, and DC. The antagonistic relationship profile ($n = 84$, 11.55%) was characterized by the highest report of antagonistic behavior of the partner and the lowest perception of love, DC, and the partner being responsive and humble. The ambivalent relationships profile ($n = 189$, 26%) was characterized by similar perceptions of affectionate and antagonistic behavior of the partner. The affectionate relationship profile included the majority of participants ($n = 454$, 62.45%) and endorsed the highest mean levels of love, DC, perceived responsiveness and humility of the partner, affectionate behavior of the partner, as well as the lowest levels of antagonistic behavior of the partner.

Correlates of Profile Group Membership

Associations of profile group membership with depression, anxiety and stress level are presented in **Table 5**. Significant differences between profile groups were evident in the depression of participants, $F_{(2,721)} = 22.31$, $p < 0.001$; their anxiety, $F_{(2,723)} = 6.74$, $p = 0.001$; their stress, $F_{(2,722)} = 25.85$, $p < 0.001$. *Post hoc* analyses showed that participants in antagonistic relationships compared with those in ambivalent and affectionate relationships reported significantly higher levels of depressive ($p = 0.001$; $p < 0.001$), anxious ($p = 0.043$; $p < 0.001$), and stress ($p = 0.013$; $p < 0.001$) symptoms. Participants in ambivalent relationships reported higher lower levels of depressive ($p = 0.005$), and stress ($p = 0.017$) symptoms compared with those in affectionate relationships, however, there was no difference in their anxiety levels ($p = 0.488$).

When categorized according to the reported symptom intensity, the prevalence of depression, anxiety, and stress experienced in affectionate relationships were the lowest with around two-thirds of participants reporting no depressive, anxiety, and stress symptoms and with <15% reporting severe or extreme symptomatology. Around half of participants in ambivalent relationships reported no depression, anxiety, and stress symptoms whereas up to 20% reported their symptoms being severe or extreme. Finally, around a third of participants in antagonistic relationships indicated experiencing no symptoms whereas another third reported experiencing severe or extreme depression, anxiety, and stress. These differences were significant [$\chi^2_{(8,724)} = 44.940$, $p < 0.001$] (**Table 6**).

DISCUSSION

The current study offers insight into how co-occurring relationship characteristics and various relationship types were differently linked to mental health outcomes, such as depression, anxiety, and stress. Relationship characteristics in this study include love, coping with stress, partner perception, and the behavior of the partner from different relationship types. The findings of the study propose profiles representing three relationship types among 727 partnered men and women who participated in the study. Most of the surveyed individuals who reported being in affectionate relationships were characterized by elevated levels of love, CDC, and the efficacy of DC. These respondents viewed their partners as responsive, humble and their behavior as high in affection, and low in antagonism. A pattern with moderate *M* values on all variables emerged among one-quarter of participants who reported being in ambivalent relationships. Ambivalent relationships revealed somewhat lower levels of love, CDC, the efficacy of DC, and perceived partner responsiveness and humility compared with affectionate relationships. The most distinctive characteristics between these two types of relationships are the levels of perceived affectionate and antagonistic behaviors of the partner; individuals in ambivalent relationships reported similar levels of both behaviors. The remaining 11.55% of respondents were in antagonistic relationships characterized by low levels of love and positive behavior with the highest rates of having experienced an antagonistic behavior of a partner. This three-profile solution is comparable to the marriage typology of Caughlin and Huston (2006) based on the relational socioemotional climate characterized by affectionate and antagonistic behavior. According to Caughlin and Huston (2006), warm marriages correspond with our affectionate relationships, hostile marriages with our antagonistic relationships, and mixed blessings marriages with our ambivalent relationships.

Comparison of mental health indices between these three relationship types showed significant differences regarding depression, anxiety, and stress. Affective relationships were associated with the best mental health functioning compared with ambivalent and antagonistic relationships. Participants in antagonistic relationships reported the worst results on depression, anxiety, and stress scales.

The association between relationship functioning and individual well-being as viewed through depression, anxiety, and stress symptoms could be bidirectional. On one hand, these findings could indicate that good relationships serve as a protective factor and poor relationships as a risk factor for mental health functioning in times of severe external stress, such as the one caused by the COVID-19 pandemic. On the other hand, the same findings could suggest that individuals whose mental health was more strongly affected by the COVID-19 pandemic perceive their relationship and their partners in a more negative light or even act in a way that harms the quality of their relationships.

Firstly, relational well-being enhances individual well-being which is consistent with the Ryff and Singer (2000) *interpersonal flourishing perspective*. Quality relationships are associated with

TABLE 3 | Summary of model selection indices of latent profile solutions for the total sample.

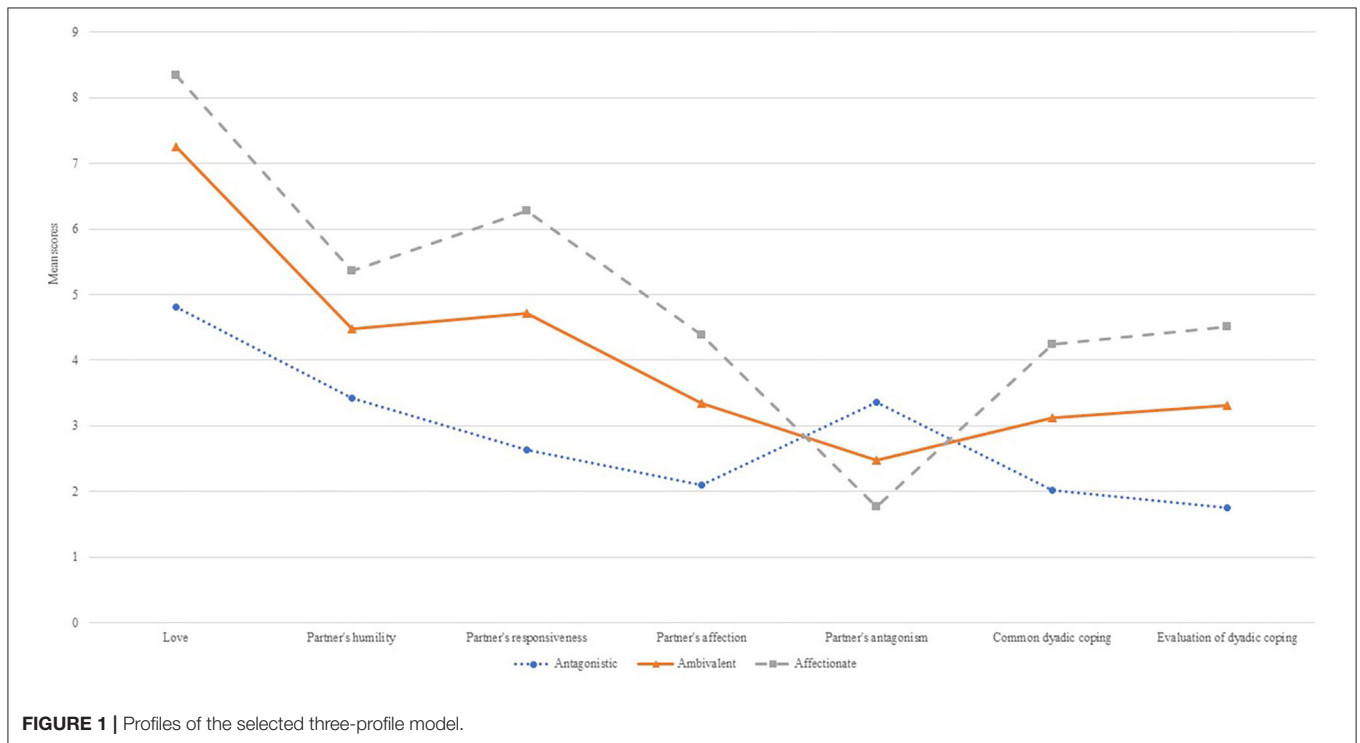
Model	AIC	BIC	SABIC	Entropy	LMR <i>p</i>	BLRT <i>p</i>	Smallest class % of <i>N</i>	<i>f</i>
1-Class	14,942.02	15,007.26	14,962.81					
2-Class	12,274.35	12,375.31	12,305.45	0.94	0.004	<0.001	24.21	176
3-Class	11,295.87	11,433.54	11,338.28	0.93	<0.001	<0.001	11.55	84
4-Class	11,020.50	11,194.80	11,074.22	0.89	0.39	<0.001	6.88	50

N = 727; The LMR test and the BLRT compare the current model with a model with *k* - 1 profiles. AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion; SABIC = Sample-Adjusted BIC; LMR = Lo-Mendell Ruben; BLRT = bootstrap likelihood ratio test; *f* = *n* of individuals in the smallest class. Fit statistics for the best-fitting model are in boldface.

TABLE 4 | Means and standard values for the three profiles.

Variable	Profile 1 Antagonistic relationships (<i>n</i> = 84)	Profile 2 Ambivalent relationships (<i>n</i> = 189)	Profile 3 Affectionate relationships (<i>n</i> = 454)
Love	5.34 (0.34)	8.08 (0.40)	9.29 (0.40)
Perceived partner humility	4.65 (0.20)	6.10 (0.19)	7.30 (0.23)
Perceived partner responsiveness	3.86 (0.24)	6.93 (0.25)	9.22 (0.34)
Partner's affectionate behavior	3.83 (0.19)	6.12 (0.25)	8.03 (0.28)
Partner's antagonistic behavior	5.19 (0.28)	3.83 (0.15)	2.73 (0.08)
Common dyadic stress coping	3.47 (0.17)	5.36 (0.22)	7.29 (0.27)
Evaluation of Dyadic Coping	2.98 (0.21)	5.64 (0.34)	7.70 (0.38)

N = 727.



future life satisfaction (Be et al., 2013) and people who describe their relationships as closer and more intimate are happier, more satisfied, and report better mental and physical

health (Mastekaasa, 1994). In line with this, bad relationships characterized by more prominent antagonistic behaviors and poor communication may increase perceived stress (Story

TABLE 5 | Means on DASS-21 for participants in three relationship types and statistics before the COVID-19 pandemic.

	Antagonistic relationships (n = 84)	Ambivalent relationships (n = 189)	Affectionate relationships (n = 454)	Averaged across all profiles	February 2020^b
Depression	16.70 (11.54)	11.83 (10.93)	8.95 (9.53)	10.67 (10.45)	11.63
Anxiety	10.67 (10.67)	7.66 (8.70) ^a	6.72 (8.88) ^a	7.42 (9.19)	4.40
Stress	20.80 (11.27)	16.54 (10.98)	13.84 (10.78)	15.34 (11.11)	10.40

N = 727; ^a Means designated with the same superscript do not differ significantly based on post hoc comparisons. All other results differ significantly based on post hoc comparisons.
^b (Jokić-Begić et al., 2020).

TABLE 6 | Prevalence of DASS-21 depression, anxiety, and stress levels in different relationship types.

		Antagonistic relationships (n = 84)	Ambivalent relationships (n = 189)	Affectionate relationships (n = 454)	Total for all relationship types
		<i>n</i> _{observed} (<i>n</i> _{expected} , % ^a)			
Depression	Normal	23 (46.3, 27.7%)	95 (104.9, 50.5%)	286 (252.8, 63.1%)	404 (55.8%)
	Mild	14 (12, 16.9%)	28 (27.3, 14.9%)	63 (65.7, 13.9%)	105 (14.5%)
	Moderate	21 (11.7, 25.3%)	30 (26.5, 16%)	51 (63.8, 11.3%)	102 (14.1%)
	Severe	9 (4.8, 10.8%)	12 (10.9, 6.4%)	21 (26.3, 4.6%)	42 (5.8%)
	Extreme	16 (8.1, 19.3%)	23 (18.4, 12.2%)	32 (44.4, 7.1%)	71 (9.8%)
Anxiety	Normal	39 (54.4, 46.4%)	119 (122.4, 63%)	312 (293.3, 68.9%)	470 (64.7%)
	Mild	6 (5.6, 7.1%)	10 (12.5, 5.3%)	32 (30.0, 7.1%)	48 (6.6%)
	Moderate	14 (10.0, 16.7%)	29 (22.4, 15.3%)	43 (53.7, 9.5%)	86 (11.8%)
	Severe	9 (4.0, 10.7%)	11 (9.1, 5.8%)	15 (21.8, 3.3%)	35 (4.8%)
	Extreme	16 (10.1, 19%)	20 (22.6, 10.6%)	51 (54.3, 11.3%)	87 (12%)
Stress	Normal	29 (44.6, 34.9%)	87 (101.7, 46%)	274 (243.7, 60.5%)	390 (53.8%)
	Mild	11 (11.3, 13.3%)	32 (25.8, 16.9%)	56 (61.9, 12.4%)	99 (13.7%)
	Moderate	15 (10.9, 18.1%)	29 (24.8, 15.3%)	51 (59.4, 11.3%)	95 (13.1%)
	Severe	14 (8.7, 16.9%)	22 (19.8, 11.6%)	40 (47.5, 8.8%)	76 (10.5%)
	Extreme	14 (7.4, 16.9%)	19 (16.9, 10.1%)	32 (40.6, 7.1%)	65 (9%)

N = 727. ^a Percentages do not always add up to 100 due to rounding up. Numbers in parentheses indicate expected count and column percentages, respectively.

and Bradbury, 2004; Bodenmann, 2005; Langer et al., 2008) through deteriorating the physical (Wickrama et al., 1997) and psychological well-being of a person (Coyne and DeLongis, 1986; Beach et al., 1998). Marital discord is significantly associated with an increased likelihood of depression (Beach et al., 2003), anxiety, and suicidal ideation (Santini et al., 2015). Additionally, poorly functioning relationships do not help buffer against acute and chronic external stressors because they lack affectionate behaviors that serve as a protective factor for the relationship and individual well-being (Conger et al., 1990). Satisfying relational and marital functioning protects against the development of psychological distress (Trudel and Goldfarb, 2010). In such satisfying relationships, partners can complement each other in terms of the resources for coping with stress (Bodenmann, 2005). When dealing with issues affecting both partners such as the COVID-19 pandemic, engaging in CDC, e.g., joint problem solving, joint information seeking, sharing of feelings, or relaxing together, alleviates negative stress impacts and also strengthens

mutual trust and intimacy that further improve the relationship regardless of gender, age, relationship duration, education, and ethnicity (Falconier et al., 2015).

Secondly, individuals with psychological difficulties such as depression or anxiety or those reporting elevated levels of stress find themselves in relationships with poorer functioning (Schnapp et al., 2020). The individual distress of partners is related to relationship quality and satisfaction (Bahun and Huić, 2017), poorer communication (Williamson et al., 2013), lowered capacities for relationship maintenance (Buck and Neff, 2012), a stronger tendency towards emotional and physical aggression (Langer et al., 2008), and an overall negative representation of the relationship (Neff and Karney, 2004). Depressed individuals tend to engage in maladaptive cognitive coping strategies such as rumination, negative metacognitive beliefs, self-blaming, and wishful thinking (Billings and Moos, 1984; Papageorgiou and Wells, 2003). Such depression is associated with poorer dyadic interactions (Bodenmann et al., 2004). Furthermore, depression

is associated with dysfunctional individual coping resources and deficits in stress communication and DC (Bodenmann et al., 2004) which has an effect on their relationship quality as well as that of their partner. Relationship functioning and mental health mutually and constantly affect each other.

The results of the study reveal that a considerable proportion of the participants show a deterioration in their mental health as expected. Participants report more symptoms of depression and stress compared with symptoms of anxiety as indicated from their depression, anxiety, and stress levels. The prevalence of depression and stress symptoms in this study is comparable to those in other COVID-19 related studies whereas anxiety levels differ (Khan et al., 2020; Shah et al., 2020; Traunmüller et al., 2020). More specifically, the anxiety levels of participants in this study were lower than that of participants in other studies.

In spite of all that COVID-19 related studies show an increase in depression, anxiety, and stress symptoms, specific results and percentages differ from study to study based on the time of data collection, sample characteristics, and the overall social situation in any given country (e.g., Khan et al., 2020; Ozamiz-Etxebarria et al., 2020; Özdin and Bayrak Özdin, 2020; Shah et al., 2020; Traunmüller et al., 2020; Wang Y. et al., 2020). Thus, the anxiety levels in this study could have been lower compared with other COVID-19 related studies due to the broader social context in which data collection took place. Participants took part in this study at the time of decrease in daily infection rates during the lockdown and after having been “locked-in” for the previous 2 months. At such a time it seemed the disease was or would soon be under control which could have lowered anxiety levels of Croatian citizens. Given lowered anxiety levels, the variability of this variable could have been reduced, potentially explaining the fact that no significant difference in anxiety between affectionate and ambivalent relationship types was found.

Overall, the results of the study highlighted the link between relationship functioning and mental health symptomatology in times of severe external stressors such as the COVID-19 pandemic and pointed out a potential area for clinical interventions. Strategies for improving relationship functioning could enable partners to co-create relationships that could serve as a protective factor in these stressful times and promote more positive health outcomes. Concurrently, organized psychosocial assistance focused on managing mental health difficulties during the COVID-19 pandemic could prove helpful to maintaining satisfying and affectionate intimate relationships which could in turn further improve the well-being of the citizens.

LIMITATIONS

Several limitations to our findings should be noted. Although we identified three relationship types using theoretically supported variables, we have focused on the experiences of only one partner in the dyad. Due to the interdependence between the partners in a relationship, future studies should include the other partner into the analysis attending to the dyadic context of people's lives to promote further understanding of mental health risks of the pandemic and their association with relationship functioning.

Additionally, most of the sample were heterosexual women which makes the interpretation of the findings limited to that subset of the population. Due to a disproportion between men and women in the sample we were unable to inquire into possible gender differences in relationship types and mental health indicators. This should be addressed in future studies. Finally, the correlational and cross-sectional nature of this research provides no insight into the direction of the association between relationship functioning and mental health outcomes or change over time and the self-report nature of this research provides no biological information. Future researchers should consider other research designs to add a deeper understanding of the topic.

CONCLUSION

The present study used LPA to identify different relationship types based on key relational variables such as love, partner perception, partner behavior, and DC. Additionally, the association between these relationship types and mental health symptoms related to the COVID-19 pandemic, such as depression, anxiety, and stress was examined. Three relationship types were identified and named antagonistic, ambivalent, and affectionate relationships. Results suggest couples in antagonistic relationships are at most risk of mental health problems compared with those in ambivalent and affectionate relationships. The affectionate relationship membership has been associated with the lowest levels of depression, anxiety, and stress. The results emphasized the link between relationship functioning and successful coping with severe external stressors that could endanger mental health.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board in Croatia at the Department of Psychology, Faculty of Humanities and Social Sciences, University of Zagreb. The participants provided their informed consent to participate in this study electronically.

AUTHOR CONTRIBUTIONS

Both authors contributed equally to the conception and the design of this work. Both authors collected the data, critically reviewed, and approved the final submitted version of the manuscript. JM: data processing, modeling, interpreting data, and manuscript writing. ŽK: interpreting data and manuscript writing. All authors contributed to the article and approved the submitted version.

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REFERENCES

- Amato, P. (2000). The consequences of divorce for adults and children. *J. Marriage Fam.* 62, 1269–1287. doi: 10.1111/j.1741-3737.2000.01269.x
- Bahun, I., and Huić, A. (2017). Intimate relationships in context: stress spillover, relationship efficacy, and relationship satisfaction. *Primenj. Psihol.* 10, 5–16. doi: 10.19090/pp.2017.1.5-16
- Baumeister, R. F. (2014). Self-regulation, ego depletion, and inhibition. *Neuropsychologia* 653, 313–319. doi: 10.1016/j.neuropsychologia.2014.08.012
- Baumeister, R. F., and Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychol. Bull.* 117:497. doi: 10.1037/0033-2909.117.3.497
- Be, D., Whisman, M. A., and Uebelacker, L. A. (2013). Prospective associations between marital adjustment and life satisfaction. *Pers. Relationsh.* 20, 728–739. doi: 10.1111/per.12011
- Beach, S. R., Fincham, F. D., and Katz, J. (1998). Marital therapy in the treatment of depression: toward a third generation of therapy and research. *Clin. Psychol. Rev.* 18, 635–661. doi: 10.1016/S0272-7358(98)00023-3
- Beach, S. R. H., Katz, J., Kim, S., and Brody, G. H. (2003). Prospective effects of marital satisfaction on depressive symptoms in established marriages: a dyadic model. *J. Soc. Pers. Relationsh.* 20, 355–371. doi: 10.1177/0265407503020003005
- Billings, A. G., and Moos, R. H. (1984). Coping, stress and social resources among adults with unipolar depression. *J. Personal. Soc. Psychol.* 46, 877–891. doi: 10.1037/0022-3514.46.4.877
- Bodenmann, G. (1995). A systemic-transactional conceptualization of stress and coping in couples. *Swiss J. Psychol.* 54, 34–49.
- Bodenmann, G. (2005). “Dyadic coping and its significance for marital functioning” in *Couples coping with stress: Emerging perspectives on dyadic coping*, eds T. Revenson, K. Kayser, and G. Bodenmann (Washington, DC: American Psychological Association), 33–50. doi: 10.1037/11031-002
- Bodenmann, G. (2008). *Dyadisches Coping Inventar: Testmanual*. [Dyadic Coping Inventory. Manual]. Bern, Switzerland: Huber.
- Bodenmann, G., Charvoz, L., Widmer, K., and Bradbury, T. N. (2004). Differences in individual and dyadic coping among low and high depressed, partially remitted, and nondepressed persons. *J. Psychopathol. Behav. Assess.* 26, 75–85. doi: 10.1023/B:JOBA.0000013655.45146.47
- Bodenmann, G., and Cina, A. (2006). Stress and coping among stable-satisfied, stable-distressed and separated/divorced Swiss couples: a 5-year prospective longitudinal study. *J. Divorce Remarr.* 44, 71–89. doi: 10.1300/J087v44n01_04
- Bodenmann, G., Ledermann, T., Blattner-Bolliger, D., and Galluzzo, C. (2006). The association between everyday stress, critical life events, and sexual dysfunction. *J. Nervous Mental Dis.* 194, 494–501. doi: 10.1097/01.nmd.0000228504.15569.b6
- Bodenmann, G., Randall, A. K., and Falconier, M. K. (2016). “Coping in couples: the Systemic Transactional Model (STM),” in *Couples Coping with Stress: A Cross-Cultural Perspective*, eds M. K. Falconier, A. K. Randall, and G. Bodenmann (Routledge/Taylor and Francis Group), 5–22.
- Bodenmann, G., and Shantinath, S. D. (2004). The Couples Coping Enhancement Training (CCET): a new approach to prevention of marital distress based upon stress and coping. *Fam. Relat.* 53, 477–484. doi: 10.1111/j.0197-6664.2004.00056.x
- Braiker, H. B., and Kelley, H. H. (1979). “Conflict in the development of close relationships,” in *Social Exchange in Developing Relationships*, eds R. L. Burgess and T. L. Huston (New York, NY: Academic), 135–168. doi: 10.1016/B978-0-12-143550-9.50011-2
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8
- Buck, A. A., and Neff, L. A. (2012). Stress spillover in early marriage: the role of self-regulatory depletion. *J. Fam. Psychol.* 26, 698–708. doi: 10.1037/a0029260
- Caughlin, J. P., and Huston, T. L. (2002). A contextual analysis of the association between demand/withdraw and marital satisfaction. *Pers. Relatsh.* 9, 95–119. doi: 10.1111/1475-6811.00007
- Caughlin, J. P., and Huston, T. L. (2006). “The affective structure of marriage,” in *The Cambridge Handbook of Personal Relationships*, eds A. Vangelisti and D. Perlman (New York, NY: Cambridge University Press), 131–155. doi: 10.1017/CBO9780511606632.009
- Choi, E., Hui, B., and Wan, E. (2020). Depression and Anxiety in Hong Kong during COVID-19. *Int. J. Environ. Res. Public Health* 17:3740. doi: 10.3390/ijerph17103740
- Conger, R. D., Elder, G. H. Jr., Lorenz, F. O., Conger, K. J., Simons, R. L., Whitbeck, L. B., et al. (1990). Linking economic hardship to marital quality and instability. *J. Marriage Fam.* 52, 643–656. doi: 10.2307/352931
- Coyne, J. C., and DeLongis, A. (1986). Going beyond social support: the role of social relationships in adaptation. *J. Consult. Clin. Psychol.* 54, 454–460. doi: 10.1037/0022-006X.54.4.454
- Cummings, E. M., and Davies, P. T. (2002). Effects of marital conflict on children: recent advances and emerging themes in process-oriented research. *J. Child Psychol. Psychiatry* 43, 31–63. doi: 10.1111/1469-7610.00003
- Cutrona, C. E., Russell, D. W., Abraham, W. T., Gardner, K. A., Melby, J. M., Bryant, C., et al. (2003). Neighborhood context and financial strain as predictors of marital interaction and marital quality in African American couples. *Pers. Relationsh.* 10, 389–409. doi: 10.1111/1475-6811.00056
- Dwiwardani, C., Ord, A. S., Fennell, M., Eaves, D., Ripley, J. S., Perkins, A., et al. (2018). Spelling HUMBLE with U and ME: the role of perceived humility in intimate partner relationships. *J. Positive Psychol.* 13, 449–459. doi: 10.1080/17439760.2017.1291849
- Ettman, C. K., Abdalla, S. M., Cohen, G. H., Sampson, L., Vivier, P. M., and Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw. Open* 3:e2019686. doi: 10.1001/jamanetworkopen.2020.19686
- European Centre for Disease Prevention and Control (2021). Data on country response measures to COVID-19. Available online at: <https://www.ecdc.europa.eu/en/publications-data/download-data-response-measures-covid-19> (accessed November 18, 2020).
- Exline, J. J., and Geyer, A. L. (2004). Perceptions of humility: a preliminary study. *Self Identity* 3, 95–114. doi: 10.1080/13576500342000077
- Falconier, M. K., Jackson, J. B., Hilpert, P., and Bodenmann, G. (2015). Dyadic coping and relationship satisfaction: a meta-analysis. *Clin. Psychol. Rev.* 42, 28–46. doi: 10.1016/j.cpr.2015.07.002
- Ferguson, S. L., and Hull, D. M. (2019). Exploring science career interest: latent profile analysis of high school occupational preferences for science. *J. Career Dev.* 46, 583–598. doi: 10.1177/0894845318783873
- Ferguson, S. L., Moore, E. W. G., and Hull, D. M. (2020). Finding latent groups in observed data: a primer on latent profile analysis in Mplus for applied researchers. *Int. J. Behav. Dev.* 44, 458–468. doi: 10.1177/016502541981721
- Frisch, M., and Simonsen, J. (2013). Marriage, cohabitation and mortality in Denmark: national cohort study of 6.5 million persons followed for up to three decades (1982–2011). *Int. J. Epidemiol.* 42, 559–578. doi: 10.1093/ije/dyt024
- Gable, S. L., Gosnell, C. L., Maisel, N. C., and Strachman, A. (2012). Safely testing the alarm: Close others’ responses to personal positive events. *J. Pers. Soc. Psychol.* 103, 963–981. doi: 10.1037/a0029488
- Gable, S. L., Reis, H. T., and Elliot, A. J. (2003). Evidence for bivariate systems: An empirical test of appetition and aversion across domains. *J. Res. Pers.* 37, 349–372. doi: 10.1016/S0092-6566(02)00580-9
- Gottman, J. M. (1994). *What Predicts Divorce?* Hillsdale, New Jersey: Erlbaum.

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- Hagenaars, J. A., and McCutcheon, A. L. (2002). *Applied Latent Class Analysis*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511499531
- Haslam, S. A., and Reicher, S. (2006). Stressing the group: social identity and the unfolding dynamics of responses to stress. *J. Appl. Psychol.* 91:1037. doi: 10.1037/0021-9010.91.5.1037
- Hatfield, E., and Rapson, R. L. (1993). *Love, Sex, and Intimacy: Their Psychology, Biology, and History*. New York, NY: Harper Collins.
- Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., and Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: a meta-analytic review. *Perspect. Psychol. Sci.* 10, 227–237. doi: 10.1177/1745691614568352
- Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 288:112954. doi: 10.1016/j.psychres.2020.112954
- Huić, A., Krznarić, T., and Kamenov, Ž. (2016). Relationship efficacy beliefs and communication patterns during conflict resolution in dating relationships—an APIM approach. IARR 2016, Toronto, Kanada.
- Huston, T. L., and Chorost, A. (1994). Behavioral buffers on the effect of negativity on marital satisfaction: a longitudinal study. *Pers. Relationsh.* 1, 223–239. doi: 10.1111/j.1475-6811.1994.tb00063.x
- Huston, T. L., Kamenov, Ž., and Huić, A. (2010). *Inventory of Affection and Antagonism in Marriage*. Unpublished material.
- Huston, T. L., and Vangelisti, A. L. (1991). Socioemotional behavior and satisfaction in marital relationships: a longitudinal study. *J. Pers. Soc. Psychol.* 61, 721–733. doi: 10.1037/0022-3514.61.5.721
- Jelić, M., Kamenov, Ž., and Huić, A. (2014). Perceived spouse's Affectionate and Antagonistic Behaviours and Marital satisfaction. *Društvena istraživanja* 23, 87–1077. doi: 10.5559/di.23.1.05
- Johns Hopkins University of Medicine Coronavirus Resource Center (2020). COVID-19 Data in Motion: Wednesday, November 18, 2020. Available online at: <https://coronavirus.jhu.edu/> (accessed November 18, 2020).
- Jokić-Begić, N., Hromatko, I., Jurin, T., Kamenov, Ž., Keresteš, G., Kuterovac Jagodić, G., et al. (2020). *Kako smo? Život u Hrvatskoj u doba korone*. [How are we? Life in time of corona]. Odsjek za psihologiju Filozofskog fakulteta.
- Karney, B. R., and Bradbury, T. N. (1995). The longitudinal course of marital quality and stability: a review of theory, methods. *Psychol. Bull.* 118, 3–34. doi: 10.1037/0033-2909.118.1.3
- Karney, B. R., and Bradbury, T. N. (2010). *Intimate Relationships*. New York, NY: W. W. Norton and Company.
- Karney, B. R., and Gauer, B. (2010). Cognitive complexity and marital interaction in newlyweds. *Pers. Relationsh.* 17, 181–200. doi: 10.1111/j.1475-6811.2010.01271.x
- Kelley, H. H. (1979). *Personal Relationships: Their Structures and Processes*. Hillsdale, NJ: Erlbaum.
- Khan, A. H., Sultana, M. S., Hossain, S., Hasan, M. T., Ahmed, H. U., and Sikder, M. T. (2020). The impact of COVID-19 pandemic on mental health & well-being among home-quarantined Bangladeshi students: A cross-sectional pilot study. *J. Affect. Disord.* 277, 121–128. doi: 10.1016/j.jad.2020.07.135
- Langer, A., Lawrence, E., and Barry, R. A. (2008). Using a vulnerability–stress–adaptation framework to predict physical aggression trajectories in newlywed marriage. *J. Consult. Clin. Psychol.* 76, 756–768. doi: 10.1037/a0013254
- Ledermann, T., Bodenmann, G., Rudaz, M., and Bradbury, T. N. (2010). Stress, communication, and marital quality. *Fam. Relat.* 59, 195–206. doi: 10.1111/j.1741-3729.2010.00595.x
- Ledermann, T., and Macho, S. (2009). Mediation in dyadic data at the level of the dyads: a structural equation modeling approach. *J. Fam. Psychol.* 23, 661–670. doi: 10.1037/a0016197
- Lo, Y., Mendell, N. R., and Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika* 88, 767–778. doi: 10.1093/biomet/88.3.767
- Lovibond, S. H., and Lovibond, P. F. (1995). Manual for the depression anxiety and stress scales. *Sydney Psychol. Found.* 14, 485–496. doi: 10.1037/t03473-000
- Marshall, A. D., Jones, D. E., and Feinberg, M. E. (2011). Enduring vulnerabilities, relationship attributions, and couple conflict: an integrative model of the occurrence and frequency of intimate partner violence. *J. Fam. Psychol.* 25, 709–718. doi: 10.1037/a0025279
- Mastekaasa, A. (1994). Marital status, distress, and well-being: an international comparison. *J. Comp. Fam. Stud.* 25, 183–206. doi: 10.3138/jcfs.25.2.183
- McLachlan, G. J. (1987). On bootstrapping the likelihood ratio test statistic for the number of components in a normal mixture. *Appl. Stat.* 36, 318–324. doi: 10.2307/2347790
- Mehulić, J., Mikac, U., and Kamenov, Ž. (2020). Constructing and validating a dyadic humility scale. 22. Days of Psychology in Zadar, Zadar, Croatia.
- Muthén, L. K., and Muthén, B. O. (2012). *Mplus User's Guide, 7th Edn*. Los Angeles, CA: Muthén and Muthén.
- Neff, L. A., and Karney, B. R. (2004). How does context affect intimate relationships? Linking external stress and cognitive processes within marriage. *Pers. Soc. Psychol. Bull.* 30, 134–148. doi: 10.1177/0146167203255984
- Neff, L. A., and Karney, B. R. (2009). Stress and reactivity to daily relationship experiences: how stress hinders adaptive processes in marriage. *J. Pers. Soc. Psychol.* 97, 435–450. doi: 10.1037/a0015663
- Neff, L. A., and Karney, B. R. (2017). Acknowledging the elephant in the room: how stressful environmental contexts shape relationship dynamics. *Curr. Opin. Psychol.* 13, 107–110. doi: 10.1016/j.copsyc.2016.05.013
- Oberski, D. (2016). “Mixture models: Latent profile and latent class analysis,” in *Modern Statistical Methods for HCI*, eds J. Robertson and M. Kaptein (Cham, Switzerland: Springer International Publishing), 275–287. doi: 10.1007/978-3-319-26633-6_12
- Otto, A. K., Laurenceau, J.-P., Siegel, S. D., and Belcher, A. J. (2015). Capitalizing on everyday positive events uniquely predicts daily intimacy and well-being in couples coping with breast cancer. *J. Fam. Psychol.* 29, 69–79. doi: 10.1037/fam0000042
- Ozamiz-Etxebarria, N., Dosal-Santamaria, M., Picaza-Gorrochategui, M., and Idoaga-Mondragon, N. (2020). Stress, anxiety, and depression levels in the initial stage of the COVID-19 outbreak in a population sample in the northern Spain. *Cad. Saude Publica.* 36:e00054020. doi: 10.1590/0102-311X00054020
- Özdin, S., and Bayrak Özdin, S. (2020). Levels and predictors of anxiety, depression and health anxiety during COVID-19 pandemic in Turkish society: The importance of gender. *Int. J. Soc. Psychiatry* 66, 504–511. doi: 10.1177/0020764020927051
- Papageorgiou, C., and Wells, A. (2003). An empirical test of a clinical metacognitive model of rumination and depression. *Cogn. Ther. Res.* 27, 261–273. doi: 10.1023/A:1023962332399
- Reis, H., and Carmichael, C. (2006). *Married Spouses' Experiences of Intimacy and Support*. Unpublished manuscript.
- Reis, H. T. (2017). “The interpersonal process model of intimacy: maintaining intimacy through self-disclosure and responsiveness,” in *Foundations for Couples' Therapy: Research for the Real World*, eds J. Fitzgerald (Routledge/Taylor and Francis Group), 216–225. doi: 10.4324/9781315678610-22
- Reis, H. T., Clark, M. S., and Holmes, J. G. (2004). “Perceived partner responsiveness as an organizing construct in the study of intimacy and closeness,” in *Handbook of Closeness and Intimacy*, eds U. D. J. Mashek and A. P. Aron (Lawrence: Erlbaum Associates Publishers), 201–225.
- Reis, H. T., Maniaci, M. R., Capriarello, P. A., Eastwick, P. W., and Finkel, E. J. (2011). Familiarity does indeed promote attraction in live interaction. *Journal of Personality and Soc. Psychol.* 101, 557–570. doi: 10.1037/a0022885
- Reis, H. T., and Shaver, P. (1988). “Intimacy as an interpersonal process,” in *Handbook of Personal Relationships*, eds S. Duck (Chichester, England: Wiley), 367–389.
- Ripley, J. S., Garthe, R. C., Perkins, A., Worthington, E. L. Jr., Davis, D. E., Hook, J. N., et al. (2016). Perceived partner humility predicts subjective stress during transition to parenthood. *Couple Fam. Psychol. Res. Pract.* 5, 157–167. doi: 10.1037/cfp0000063
- Ryff, C. D., and Singer, B. (2000). Interpersonal flourishing: a positive health agenda for the new millennium. *Pers. Soc. Psychol. Rev.* 4, 30–44. doi: 10.1207/S15327957PSPR0401_4
- Santini, Z. I., Koyanagi, A., Tyrovolas, S., and Haro, J. M. (2015). The association of relationship quality and social networks with depression, anxiety, and suicidal ideation among older married adults: findings from a cross-sectional analysis of the Irish Longitudinal Study on Ageing (TILDA). *J. Affect. Disorders* 179, 134–141. doi: 10.1016/j.jad.2015.03.015
- Schnapp, J. E., O'Neal, D. N., and Vaughn, A. A. (2020). Dyadic perceptions of depression and anxiety in romantic relationships. *J. Soc. Pers. Relat.* 37, 432–449. doi: 10.1177/0265407519867418

- Shah, S. M. A., Mohammad, D., Qureshi, M. F. H., et al. (2020). Prevalence, psychological responses and associated correlates of depression, anxiety and stress in a global population, during the coronavirus disease (COVID-19) pandemic. *Commun. Mental Health J.* 57, 101–110. doi: 10.1007/s10597-020-00728-y
- Slavich, G. M. (2020). Psychoneuroimmunology of stress and mental health. *The Oxford Handbook of Stress and Mental Health*. New York: Oxford University Press. doi: 10.1093/oxfordhb/9780190681777.013.24
- Smith, D. A., Vivian, D., and O'Leary, K. D. (1990). Longitudinal prediction of marital discord from premarital expressions of affect. *J. Consult. Clin. Psychol.* 58, 790–798. doi: 10.1037/0022-006X.58.6.790
- Story, L. B., and Bradbury, T. N. (2004). Understanding marriage and stress: Essential questions and challenges. *Clin. Psychol. Rev.* 23, 1139–1162. doi: 10.1016/j.cpr.2003.10.002
- Taylor, S. E. (2006). *Health Psychology*. McGraw Hill
- Tein, J. Y., Coxe, S., and Cham, H. (2013). Statistical power to detect the correct number of classes in latent profile analysis. *Struct. Equ. Model.* 20, 640–657. doi: 10.1080/10705511.2013.824781
- Traunmüller, C., Stefitz, R., Gaisbachgrabner, K., and Schwerdtfeger, A. (2020). Psychological correlates of COVID-19 pandemic in the Austrian population. *BMC Public Health* 20:1395. doi: 10.1186/s12889-020-09489-5
- Trudel, G., and Goldfarb, M. R. (2010). Marital and sexual functioning and dysfunctioning, depression and anxiety. *Sexol. Eur. J. Sexol. Sexual Health* 19, 137–142. doi: 10.1016/j.sexol.2009.12.009
- Vangelisti, A. L., and Huston, T. L. (1994). "Maintaining marital satisfaction and love," in *Communication and relational maintenance*, eds D. J. Canary and L. Stafford (New York, NY: Academic Press), 165–186.
- Vukčević Marković, M., Bjekić, J., and Priebe, S. (2020). Effectiveness of expressive writing in the reduction of psychological distress during the COVID-19 pandemic: A randomized controlled trial. *Front. Psychol.* 11:587282. doi: 10.3389/fpsyg.2020.587282
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., et al. (2020). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behav. Immun.* 87, 40–48. doi: 10.1016/j.bbi.2020.04.028
- Wang, Y., Zhang, D., Du, G., Du, R., Zhao, J., Jin, Y., et al. (2020). Remdesivir in adults with severe COVID-19: a randomised, double-blind, placebo-controlled, multicentre trial. *Lancet* 395, 1569–1578. doi: 10.1016/S0140-6736(20)31022-9
- Weidman, A. C., Cheng, J. T., and Tracy, J. L. (2018). The psychological structure of humility. *J. Pers. Soc. Psychol.* 114, 153–178. doi: 10.1037/pspp0000112
- Whisman, M. A., and Uebelacker, L. A. (2006). Impairment and distress associated with relationship discord in a national sample of married or cohabiting adults. *J. Fam. Psychol.* 20, 369–377. doi: 10.1037/0893-3200.20.3.369
- Wickrama, K. A. S., Lorenz, F. O., and Conger, R. D. (1997). Marital quality and physical illness: a latent growth curve analysis. *J. Marriage Fam.* 59, 143–155. doi: 10.2307/353668
- Williamson, H. C., Karney, B. R., and Bradbury, T. N. (2013). Financial strain and stressful events predict newlyweds' negative communication independent of relationship satisfaction. *J. Fam. Psychol.* 27, 65–75. doi: 10.1037/a0031104
- Worthington, E. L., Davis, D. E., and Hook, J. N. (2016). *Handbook of Humility: Theory, Research, and Applications*. New York, NY: Routledge. doi: 10.4324/9781315660462
- Wozidlo, A., and Segrin, C. (2013). Direct and indirect effects of newlywed couples' neuroticism and stressful events on marital satisfaction through mutual problem solving. *Marriage Fam. Rev.* 49, 520–545. doi: 10.1080/01494929.2013.772933
- Wright, J. C., Nadelhoffer, T., Ross, L., and Sinnott-Armstrong, W. (2017). Be it ever so humble: Proposing a dual-dimension account and measurement of humility. *Self Identity* 17, 92–125. doi: 10.1080/15298868.2017.1327454
- Zissimopoulos, J. M., Karney, B. R., and Rauer, A. J. (2013). Marriage and economic well being at older ages. *Rev. Econ. Household* 13, 1–35. doi: 10.1007/s11150-013-9205-x

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