COMPARISON OF FOOTBALL REFEREES' PHYSIOLOGICAL LOADS BETWEEN TWO MATCH HALVES

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ABSTRACT

The main aim of this research was to analyse differences in physiological loads of football referees between first and second half of the official football matches. The sample of respondents consists of 10 main football referees who are on the refereeing list of the SuperSport Croatian Football League. Results of study shows that referees are under high physiological loads during matches. Neither minimum, maximum, or average heart rate during official matches in football does not have significant differences between halves in a match. Based on the obtained results in this study it can be concluded that football referees are exposed to high physical and physiological loads during the match. Although, during official football matches there is always a constant physiological stress on the referees and there in no significant difference in physiological loads of the referees between first and second half of a football match. Referees must be physically and mentally fit and they must cope with pressure at the highest possible level throughout the match.

Key words: *physiological stress; match periods; decision making*

INTRODUCTION

In football there is one main referee which has direct communication and help from two assistant referees and fourth official referee. In leagues which have VAR (video assistant referee) technology there are VAR referee and AVAR referee which are on direct line with the main referee and help with decisions for critical situations based on video replays. Because of modern football, which is very demanding both physically and mentally, referees have a high physiological load during matches. This is the reason why the physical preparation of referees must be at a level that avoids fatigue and physical exhaustion during matches, because it is physical exhaustion that is an indicator of poor physical preparation of referees, which consequently prevents proper decision-making (Matković and Nedić, 2012). The development of individual motor skills allows football referees to be as close as possible to the place where they have to make a decision on the field. Making that decision is more precise and faster if the referees are closer to the event and for that they need a higher level of physical preparation (Castagna et al., 2007; Mallo et al., 2012; Matković and Nedić, 2012). Research by several groups of authors in different team sports where a large volume of movement dominates (Harley et al., 1999; Castagna et al., 2007; Lategan, 2011; Mallo et al., 2012; Matković and Nedic, 2012; Luis 2015) are showed that the distance of the referees from the place of the event on the field where the referees have to make a decision is very important for proper refereeing. The correctness of decision-making depends on the position on the field where the event occurred, the level of fitness preparedness of the referees and the time in the match when the decision was made (Lategan, 2011; Birinci et al., 2014; Nazarudin et al.,

2015; Castillo et al., 2015; Mazaheri et al., 2016). Looking at the opposite situation, where the referee is at too far distance from the event, which occurs in the phase of physical fatigue, the risk of a wrong decision increases, given that the visibility is not clear enough (Rupčić, 2010; Mallo et al., 2012; Elsworthy, 2014). The physical and physiological demands of referees are similar to the demands of players in football, which is very challenging as referees are mostly older than players. So, for the referees at utmost importance is to keep their training structure at correct volume, intensity, specificity to keep up with the demands of the game.

The main aim of this study is to determine whether there is a difference between two halves in a football match considering physiological loads of the football referees.

METHODS

Respondents sample

The sample of respondents consists of 10 main football referees who are on the refereeing list of the SuperSport Croatian Football League, which is the highest rank of competition in Croatia. The sample of matches is 20, which means that two matches per referee were analysed. The list of referees is defined every year by the professional referee committee of the Croatian Football Federation.

Variables Sample

Variables for this research consist of three different kinds of variables:

- Anthropometric
  - body height (BH)
  - body weight (BW)
- Functional
  - minimum heart rate (HR min)
  - maximum heart rate (HR max)
- Physiological
  - minimum heart rate during first half of the match (HRmin1)
  - minimum heart rate during second half of the match (HRmin2)
  - maximum heart rate during first half of the match (HRmax1)
  - maximum heart rate during second half of the match (HRmax2)
  - average heart rate during first half of the match (HRavg1)
  - average heart rate during second half of the match (HRavg2)

Study Protocol

Each referee needed to bring medical certificate confirming that they are healthy and ready for testing of functional abilities. After this all referees signed a voluntary approval statement confirming they are known with all the risks of testing and that they agree to be tested. The testing of football referees was conducted in two separate parts.

First part of the testing was measuring anthropometric characteristics of the referees. This was conducted in laboratory conditions at the Diagnostic Center of the Faculty of Kinesiology of the University of Zagreb.

The second part of testing was conducted during the official matches of the SuperSport Croatian football league as field testing. Before the match start all the referees had GPS device STATSports (Apex, London, UK) which was placed just below their neck from back side of the body and between scapulas. Also referees had heart rate monitor system RS800 (Polar, Tampere, Finland) which was placed on their chest. Both devices were invisible to spectators or players, but very comfortable and pleasant for referees.

Data Analysis

The statistical software package Statistica v.13.05.0.17 (TIBCO software Inc) was used for the statistical analysis. Data distribution is verified with the use of the Kolmogorov-Smirnov test. Central and dispersion

parameters, arithmetic mean and standard deviation were calculated for two halves of football match. Differences between the two periods of football matches were tested by t-test for independent samples and the level of significance was set at $p < 0.05$.

RESULTS

In Table 1. descriptive statistical parameters and distribution parameters are shown. For each variable, basic statistical parameters as arithmetic mean, standard deviation were calculated. Minimum value, maximum value, skewness, and kurtosis of distribution are also added.

Table 1. Descriptive statistical and distribution parameters

N = 20	Mean	Min	Max	StDev	Skewness	Kurtosis
HR min 1p	107,53	75,00	125,00	17,32	-0,82	-0,63
HR max 1p	176,82	155,00	192,00	13,07	-0,37	-1,47
HR min 2p	109,88	79,00	130,00	17,37	-0,67	-1,00
HR max 2p	176,29	142,00	192,00	14,18	-0,94	0,59
HR avg 1	150,24	130,00	172,00	16,00	0,04	-1,80
HR avg 2	147,53	117,00	168,00	16,18	-0,25	-1,27

***Legend**: HR min 1p – minimum heart frequency during 1. period, HR max 1p – maximum heart frequency during 1. period, HR avg 1 – average heart frequency during 1. period, HR min 2p – minimum heart frequency during 2. period, HR max 1p – maximum heart frequency during 2. period, HR avg 2 – average heart frequency during 2. period*

The results presented in Table 2. shows there are no statistically significant differences between variables of minimum heart rate during first and second half of a football match.

Table 2. T-test for independent samples for variables minimum heart rate (HR min) during first and second half of a football match

N = 20	Mean1	Mean2	t	df	p	St.Dev1	St.Dev2	F	p
HR min 1P / 2P	107,5	109,9	-0,40	32	0,69	17,32	17,37	1,01	0,99

The results presented in Table 3. shows there are no statistically significant differences between variables of maximum heart rate during first and second half of a football match.

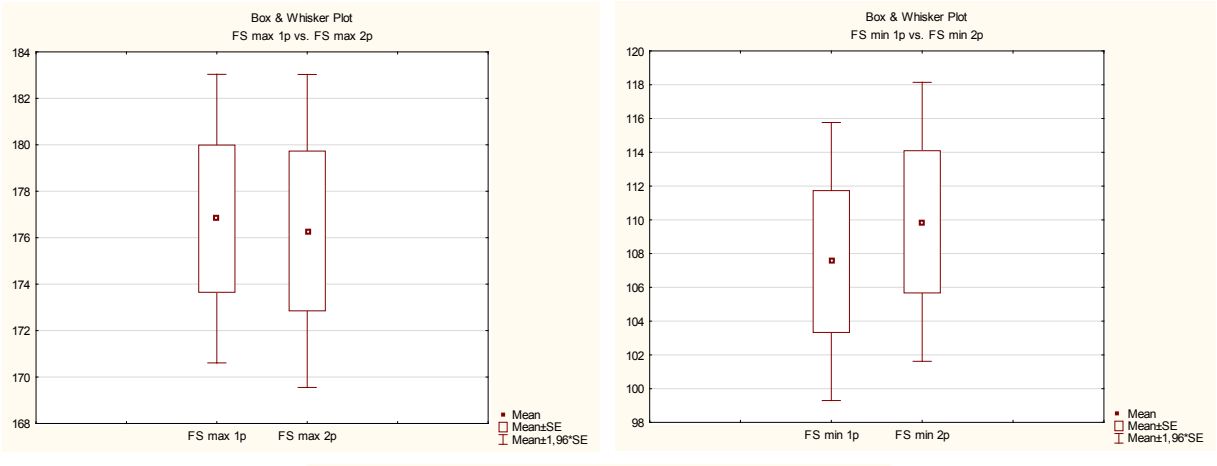
Table 3. T-test for independent samples for variables average heart rate (HR max) during first and second half of a football match

N = 20	Mean1	Mean2	t	df	p	St.Dev1	St.Dev2	F	p
HR max 1P / 2P	176,82	176,29	0,11	32	0,91	13,06	14,17	1,177	0,75

The results presented in Table 4. shows there are no statistically significant differences between variables of average heart rate during first and second half of a football match.

Table 4. T-test for independent samples for variables average heart rate (HR avg) during first and second half of a football match

N = 20	Mean1	Mean2	t	df	p	St.Dev1	St.Dev2	F	p
HR avg 1P / 2P	150,24	147,53	0,49	32	0,62	16,00	16,18	1,02	0,97



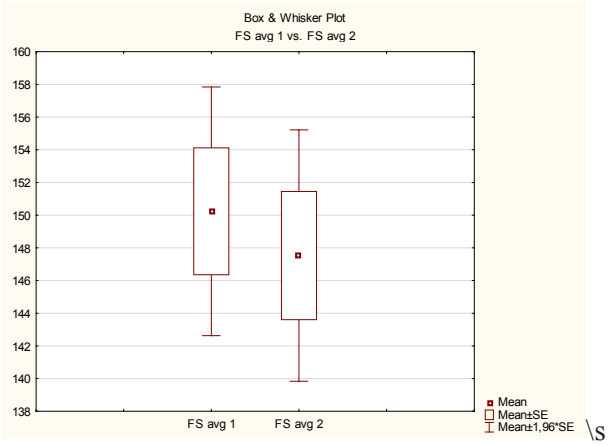


Figure 1, 2 and 3. Graphical dispersion of the results in variables minimum, maximum and average heart rate during the first and second half of the match

DISCUSSION

The main aim of this research was to analyse differences in physiological loads of football referees between first and second half of the official football matches. Results of study shows that referees are under high physiological loads during matches. Neither minimum, maximum or average heart rate during official matches in football does not have significant differences between halves in a match. Based on the obtained results in this study it can be concluded that football referees are exposed to high physical and physiological loads during the match. Although, during official football matches there is always a constant physiological stress on the referees and there in no significant difference in physiological loads of the referees between first and second half of a football match. Referees must be physically and mentally fit and they must cope with pressure at the highest possible level throughout the match. This means that referees need to be concentrated and fully prepared as there is no difference in intensity of the game, and especially in the demands of football referees during match.

Looking at the basic descriptive parameters of referees there is very interesting data showing that referees minimum heart rate during the match is very high according to their minimum frequency which was measured during laboratory testing. This data is just confirming previously published research from Titlebaum (2009). This is just confirming that referees are under big pressure during, before and after the match. Because of this one of the most important preparations for the match is psychological preparation as referees must be ready to endure psychological pressure (Mirjamali, 2012). This is mostly reflected in matches which can decide outcome of knockout phase of the competition, full competitions or similar important events which are globally watched. Results of the t-test for independent samples (Table 2) shows there are no statistically significant differences ($p < 0.69$) in average minimum heart frequency of referees between first and second half of a football match. Average minimum heart rate mean numbers show only 2 beats difference between halves of a football matches. Also, result of t-test for independent samples in variable

maximum heart frequency of referees during first and second half (Table 3.) shows no significant differences ($p < 0.91$). It is very interesting to see that average data for both halves are almost identical 176.82 bpm and 176.29 bpm) This shows that football referees are under same physical and psychological pressure during both halves of the match. It is utmost importance for football referees to be at a physical shape which will allow them to follow all the demands of the match and especially to be as close to events as possible and to prevent making mistakes in their decisions. This is especially important during high intensity periods in the match, or when match goes to final stages of the halves as one bad decision can have an impact on the final result of the match.

The pressure in the match is bigger as stakes rise, and the more important game is. Regarding those conditions the loads in the game are also bigger and the decisions of the referees are watched trough and trough again and again as they can affect the final result of the matches and the competition (Elsworthy, 2014; Caballero i sur., 2015; Brightmore i sur., 2016). The results of this study are very similar to the results obtained in other studies which have researched physiological loads of referees during matches but in other team sports. They have found also no statistically significant differences between periods in the game (D'Ottavio and Castagna, 2001, Rupčić 2010, Belčić et al., 2018)

CONCLUSION

Based on the obtained results in this study it can be concluded that football referees are exposed to high physical and physiological loads during the match. Although, during official football matches there is always a constant physiological stress on the referees and there in no significant difference in physiological loads of the referees between first and second half of a football match. Referees must be physically and mentally fit and they must cope with pressure at the highest possible level throughout the match. Also, their physical condition must be at the level which allows them to follow physiological requirements of the official match and to make proper and a perfectly timed decision and this will only be possible if they will be as close as possible to the event on the pitch which demands their decision.

LITERATURE

1. Belčić, I.; Marošević, A. i Sukreški, M. (2018). Differences in physiological loads and energy consumption of handball referees between periods in handball match // World Congress of Performance Analysis in Sport XII: proceedings / Škegro, Dario ; Belčić, Ivan ; Sporiš, Goran ; Krističević, Tomislav (ur.). Zagreb: Kineziološki fakultet Zagreb, 357-363
2. Birinci, M., Yılmaz, A., Erkin, A., Sahbaz, S. i Aydın, I. (2014). Determination of Relationship between Respiratory Parameters and Aerobic Capacity of Referees. Procedia - Social and Behavioral Sciences, 152, 353-357.
3. Brightmore, A., O'Hara, J., Till, K., Cobley, S., Hubka, T., Emmonds, S. i Cooke, C. (2016). Movement and Physiological Demands of Australasian National Rugby League Referees. International Journal of Sports Physiology and Performance. 11(8), 1080-1087.
4. Caballero J., Ojeda, E., Garcia-Aranda, J., Mallo, D., Helsen, W., Sarmiento, S., Veldivielso, M.N. i Garcia-Manso, J.M. (2011). Physiological profile of national-level Spanish soccer referees. International Sportmed Journal for Fims, 2 (2), 85-91.
5. Castagna, C., Abt, G. i D'Ottavio, S. (2004). Activity Profile of International-Level Soccer Referees During Competitive Matches. Journal of Strength and Conditioning Research. 18(3), 486-496.
6. Castillo, D., Yanci, J., Casajús, J. i Cámara, J. (2016). Physical fitness and physiological characteristics of soccer referees. Science & Sports, 31(1), 27-35.
7. D'Ottavio, S., Castagna, C. (2001.). Physiological load imposed on elite soccer referees during actual match play. Journal of Sports Medicine and Physical Fitness 41 (1), 27-32.
8. Elsworthy, N., Burke, D. i Dascombe, B.J. (2014). Factors relating to the decision-making performance of Australian football officials. International Journal of Performance Analysis in Sport. 14, 401-410
9. Lategan, L. (2011). Physiological profiles of South African soccer referees and assistant referees. African Journal for Physical Health Education, Recreation and Dance. 17(4), 675-693.

10. Luis, V., Canelo, A., Morenas, J., Gómez-Valadés, J. i Gómez, J. (2015). Comportamiento visual de árbitros de futbol en situaciones de fuera de juego / Referees' Visual Behaviour During Offside Situations In Football. International Journal of medicine and science of physical activity and sport. 58, 325-338
11. Mallo, J., Frutos, P., Juárez, D. i Navarro, E. (2012). Effect of positioning on the accuracy of decision making of association football top-class referees and assistant referees during competitive matches. Journal of Sports Sciences. 30(13), 1437-1445.
12. Matković, B. and Nedić, A. (2012). Anthropological profile of soccer referees. Croatian Sports and Medicine Journal, 27, 61-71.
13. Mazaheri, R., Halabchi, F., Seif Barghi, T. i Mansournia, M. (2016). Cardiorespiratory Fitness and Body Composition of Soccer Referees; Do These Correlate With Proper Performance? Asian Journal of Sports Medicine, 7(1).
14. Nazarudim, N.M., , Abdullah, M.R., Suppiah, P.K., Fauzee, M.S.O., Parnabas, V. i Abdullah, N.M. (2015). Decision making and performance of Malaysian rugby sevens referees. Movement, Health & Exercise, 4.
15. Rupčić, T. (2010). Fiziološko opterećenje sudaca tijekom košarkaške utakmice. Doktorska disertacija, Kineziološki fakultet, Sveučilište u Zagrebu.