Relationship between Morphological Features and Lower Limb Explosive Strength in Boys

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Abstract
The aim of this study was to investigate the correlation between morphological characteristics and lower limb explosive strength. The sample consisted of 100 male respondents aged 4 to 18 years. Variables was composed of 12 anthropometric characteristics, percentage of body fat and vertical jump. For establishment the relationship between morphological features and lower limb explosive power Pearson's correlation coefficient was calculated. The result indicated that there is a statistically significant positive correlation between the morphological characteristics that are predisposed by regular growth and development (body height, arm length, leg length, etc.) and the explosive strength. Also, it shown statistically significant negative correlation between the variables that are indicators of wellbeing (fat percentage, skin folds) and motor performance. It can be concluded that boys who are overweight and obese reported poorer results in motor skill. Therefore, it is very important for children to be physically active to maintain normal health status.
Keywords: Anthropometric characteristics, Children, Motor abilities, Physical activities

Introduction

Morphological features (i.e. somatotype and body configuration) have an essential part in the performance of numerous physical actions (Saha, 2015). Somatotyping has a quite long practice in human biology. In the meantime of the early growth of Sheldon's somatotyping system, investigators have researched the association of somatotype and body composition to physical performance (Raudsepp and Jurimae, 1996). A youth finishes dissimilar stages of motor actions which be influenced by mechanic demands and morphological features (Bjelica, Gojković, Pržulj, Cicović and Joksimović, 2018).

The quantification of muscular ability seems to be of main significance in the identification of the prospective for motor enactment. Between experts, the agreement is that muscular power (or "explosive strength" as frequently converted into practice) is greatest significant for success in numerous everyday lifespan jobs as well as in physical activities. But muscular power is determined by a several of aspects, amongst them neuro motor (e.g., variations in coordination), biomechanical (e.g., muscle contraction physiognomies) plus somatotype and body configuration (Liebermann and Katz, 2003).

Vertical jump is frequently used as an manifestation for the power of the lower limb or explosive leg power (Chu, 1996; Moir, Button, Glaister and Stone, 2004; Richards, 1968; Shellock and Prentice, 1985). Vertical jumping skill is an significant essential ability for many physical actions. Vertical jump height is a dimension that trainers, health care experts, and strength and conditioning specialists regularly practice as an objective functional dimension (Waggener, Barfield and Sessoms, 2002). Papers concentrated on vertical jump concerning

performances propose distinct tests of characteristics for different age groups, followed by morphological features which may essentially affect the performances (Haguenauer, Legreneurm and Monteil, 2005), as well as gender and genetic indicators (Okely and Booth, 2004). Accorngly, countermovement jump without arm swing is commonly used test for define an explosive strength, also lower limb explosive strength is a very important fragment of basic motor abilities that indicates and is in relation with health and quality of life of children. Lepes, Papp, Ihasz, Nagyvaradi and Zrnzevic (2019) in their study concluded that boys who accomplished superior outcomes on measurements of motor abilities are additional physically active, filled of energy, feel well, spend extra period with associates and adore the care of their earls.

So, the objective of this study was to investigate the correlation between morphological features and lower limb explosive strength between boys from early age till adolescent age. From the objective of the study the null hypothesis are appointed. The first hypothesis is that there is a statistically significant positive correlation between anthropometric characteristics that reflect the proper growth and development in accordance with the age and vertical jump in all age groups of respondents. Another hypothesis is that there is a statistically significant negative correlation between the variables which are indicators of obesity (skin folds and body fat percentage) and the vertical jump.

Method

According to the purpose of this study, the investigation was provided on population of boys from early age in kindergartens to adolescents in high schools. Therefore, the sample consisted of 100 male respondents aged 4 to 18 years. The research was conducted in kindergartens and schools from city of Zagreb. All children included in investigation were healthy and parental permissions were collected. The measurements were carrying out in morning hours always by the same educate experts from Faculty of Kinesiology. Variables included in this study was composed of 12 anthropometric characteristics (BH-body height, AL-arm length, LL-leg length, ED-elbow diameter, AD-ankle diameter, SW-shoulder width, BW-body weight, UC-upper arm circumference, LC-lower leg circumference, BS- back skin-fold, US- upper arm skin-fold, SS- suprapatellar skin-fold), percentage of body fat (BF%) and vertical jump without arm swing on platform (CJ-Countermovement Jump). All collected data was analyzed by program Statistica 13.0. For all variables descriptive parameters were calculated (arithmetic mean, minimal results, maximal results, standard deviation). On behalf of normality of distribution Kolmogorov-Smirnov test was provided. In place of founding the connection between morphological features and lower limb explosive strength Pearson's correlation coefficient was calculated.

Findings

In attendance to investigate the relationship between morphological characteristics and motor abilities, precisely lower limb explosive strength, in boys and adolescents the measurements in kindergartens and schools were provided and the following results were collected. The obtained outcomes were analyzed and showed in Tables 1. to 5. Descriptive parameters show the highest range of results in variable *body height,* and the lowest standard deviation in variable *suprapatellar skinfold* (Table 1.). The minimum jump was 12,07cm, and the maximum countermovement jump was 50,77cm. In this table it is not detailed, but from results of descriptive parameters for specific age it is clear that with age the skinfolds of respondent's drastic extent.

Table 1. Descriptive parameters of morphological features and vertical jump

Variables	Valid N	Mean	Minimum	Maximum	Std.Dev.
BH	100	150,16	108,30	196,50	24,66
AL	100	63,42	44,40	84,40	11,26
LL	100	85,11	55,60	109,50	16,11
ED	100	59,39	37,00	86,00	11,82
AD	100	65,69	53,00	83,00	7,17
SW	100	22,37	13,60	35,20	5,64

BW	100	47,09	17,28	123,64	22,22
UC	100	25,31	15,60	39,40	5,96
LC	100	33,12	21,00	47,80	6,53
BS	100	9,71	4,00	29,00	5,99
US	100	11,54	5,00	27,00	5,73
SS	100	10,70	4,67	25,33	4,64
BF%	100	22,58	11,69	45,45	7,86
CJ	100	29,98	12,07	50,77	9,74

Table 2. shows correlations of morphological features and vertical jump of all respondents (second column) . Simultaneous shows separately correlations of al measured variables in boys from kindergarten aged 4 to 6 years. From marked correlations for all subjects it can be seen that all anthropometric characteristics, except skinfolds and body fat %, are significantly positive connected with vertical jump. That can be discussed that accordingly with age and regular development the boys can expressed their motor ability as it is expected, the motor ability improves. Moreover in young boys aged 4 and 5 there is no statistical significantly connections because in that age the movement coordination and motor knowledge of vertical jump is not clear jet. In age of 6 the connections are marked and in that period boys who have more body fat % and back and upper arm skinfold performed purer result in vertical jump.

Table 2. Correlations of morphological features and vertical jump of all respondents and separately boys from kindergarten

Variables	CJ-all	CJ-age4	CJ-age5	CJ-age6
BH	0,85*	0,03	0,36	0,10
AL	0,84*	-0,04	0,11	-0,41
LL	0,86*	-0,39	0,27	0,54
ED	0,75*	-0,28	0,25	0,58
AD	0,72*	0,62	0,28	-0,13
SW	0,79*	-0,01	0,25	0,35
BW	0,70*	0,30	0,42	-0,28
UC	0,49*	0,07	0,22	-0,22
LC	0,59*	0,08	0,59	-0,34
BS	0,11	0,19	0,51	-0,58*
US	-0,08	0,38	0,14	-0,77*
SS	-0,24*	0,06	0,51	-0,21
BF%	0,11	0,33	0,25	-0,70*

*-statistically significant correlations on p≤0,05

Furthermore, the similar results are presented for boys in the age of seven (Table 3.) It can be seen that there is positive correlations of all anthropometric characteristics with vertical jump. That is expected because it is normal that subject who is taller and have longer arms and legs, and stronger body jumps higher. But simultaneously, boys who have higher value of back skinfold, upper-arm skinfold, suprapatellar skinfold and body fat % have negative associations with vertical jump. That means that subject who are overweight presents weaker outcomes in basic motor abilities, precisely explosive strength.

Table 3. Correlations of morphological features and vertical jump of boys younger school age

Variables	CJ-age7	CJ-age8	CJ-age9	CJ-age10
BH	0,61	-0,28	-0,21	0,26
AL	0,90*	-0,60	0,08	0,25
LL	0,43	-0,44	-0,38	0,36
ED	0,90*	-0,49	-0,18	-0,03
AD	0,76	-0,19	0,26	-0,06

SW	0,93*	-0,51	-0,27	0,10
BW	0,63	-0,48	-0,18	0,05
UC	0,47	-0,56	0,06	-0,18
LC	0,53	-0,27	-0,59	-0,68
BS	-0,27	-0,69*	-0,24	0,04
US	-0,27	-0,55*	-0,24	0,06
SS	-0,16	-0,76*	-0,10	-0,27
BF%	-0,28	-0,60*	-0,24	0,12

*statistically significant correlations on p≤0,05

Consequently, with age of respondents the statistically significant connections between morphological features and vertical jump are more expressed. From results of correlation analysis showed in Table 4. and Table 5. it can be seen that for boys from 11 to 14 years of age, who are in pubertal stage, is very important their physical condition to express great result in explosive strength of lover limbs. The same report goes for adolescents (Table 5.). In that period of life, there is no matter if the subject is higher and their body and bones are developed by age, it is more important that they have regular body mass. For the same reason, boys and adolescents who are obese and overweight accomplished purer results in their motor abilities which indicate bad physical condition and cautions of a high risk of cardiovascular disease and diabetes in later age.

Table 4. Correlations of morphological features and vertical jump of boys middle school age

Variables	CJ-age11	CJ-age12	CJ-age13	CJ-age14
BH	0,60	0,45	-0,50	0,19
AL	0,41	0,58	-0,61	0,10
LL	0,51	0,82*	-0,44	0,43
ED	0,46	-0,69	-0,94*	-0,46
AD	0,23	0,24	-0,36	0,07
SW	0,27	-0,21	-0,69	-0,21
BW	-0,09	-0,24	-0,87*	-0,50
UC	0,02	0,23	-0,49	0,23
LC	-0,08	-0,04	-0,80	-0,42
BS	-0,53*	-0,31	-0,51*	-0,61*
US	-0,51*	-0,47	-0,47	-0,67*
SS	-0,56*	-0,60*	-0,72*	-0,47
BF%	-0,49	-0,48	-0,35	-0,61*

*-statistically significant correlations on p≤0,05

Table 5. Correlations of morphological features and vertical jump of boys high school age

Variables	CJ-age15	CJ-age16	CJ-age17	CJ-age18
BH	-0,24	0,28	-0,01	-0,62
AL	0,07	-0,17	-0,23	-0,77
LL	0,08	0,26	0,12	-0,58
ED	-0,17	-0,69	-0,29	-0,74
AD	-0,14	-0,40	-0,20	-0,69
SW	-0,80*	0,51	0,01	-0,80
BW	-0,61	0,90*	-0,38	-0,58
UC	-0,51	0,52	-0,20	-0,28
LC	-0,38	0,51	0,40	-0,36
BS	-0,70*	0,17	-0,31	-0,64*
US	-0,56*	-0,11	0,11	-0,32
SS	-0,54*	-0,53*	-0,28	-0,58*
BF%	-0,55*	-0,01	-0,11	-0,13

*-statistically significant correlations on p≤0,05

According to the foundlings of this research the hypothesis can be confirmed. There is a statistically significant positive correlation between anthropometric characteristics that reflect the proper growth and development in accordance with the age and vertical jump in all age groups of respondents, also there is a statistically significant negative correlation between the variables which are indicators of obesity (skin folds and body fat percentage) and the vertical jump.

Results, Conclusions and Recommendations

The results in this study indicated that accordingly with age and regular growth and development the boys can express their motor ability as it is expected, the motor ability improves. From this statement it can be concluded that respondents who are mature can jump higher i.e. they have a better developed explosive power because they are older, taller, and stronger which is normal. But also in the direction of results of this research subjects from the age of 6 (primary school) till adolescents stage (high school) who have higher values on measurement in body fat %, back skinfold, upper arm skinfold and suprapatellar skinfold performed purer result in vertical jump. On behalf of these results it can be concluded that boys and adolescents who are obese and overweight offerings lower effects in basic motor abilities, accurately explosive strength. Saha (2015) similarly investigate the influence of morphological characteristics on explosive power. His results shown that vertical jump is significantly positively correlated with skeletal muscle %, lean body mass, mesomorph and ectomorph somatotype; but also body mass, body fat % and endomorph somatotype are significantly negatively correlated. From the given results Saha also concluded that somatotype and body composition variables are important factors in determining leg explosive power. Furthermore, Marta et al. (2013) examine the impact of body fat and somatotype on explosive strength in the prepubertal children. The data of their investigation applaud that somatotype has a large effect on explosive strength. Specifically, endomorphs have a negative influence on vertical jump gains while mesomorphs have a significant positive influence and that should not be ignored because the majority of body fat can be essential aspects affecting physical condition and normal development. The relationship between anthropometric characteristics and motor abilities of boys from first grade of elementary school investigate Rodić (2012). In his study obtained result showed negative relations between body mass and explosive strength. From that outcome he also concluded that anthropometric features of boys are very essential for the execution of motor abilities. Agreeing to the results of this investigation it can be concluded that for proper physical condition, healthy growth and development it is necessary to regularly monitor morphological features of children. In that period of life, from earliest age till adolescence, it is very important for children to have regular body mass and somatotype to prevent the occurrence of coronary heart disease and diabetes.

Recommendation for further studies is to investigate the relationship between morphological characteristics and other basic motor abilities such as coordination, speed, flexibility, balance and precision. Also it would be interesting to provide the measurements on girls from kindergarten till high school and compare their performance in motor tasks regarding to anthropometric characteristics, specially body fat% and skinfolds. In that case there would be covered the pattern of all children and the entire motor space. Those foundlings would be of great importance for parents, educators, teachers and trainers who must be a motivating factor in today's era of digitalization. The children must daily exercise and have proper nutrition to be healthy people, and not to spend time sedentary in front of screens.

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