UDC: 796.431.2.012.13:572.087.1-057.874(497.721)
Original scientific paper

MORPHOLOGICAL PARAMETERS AND SPEED AS PREDICTORS OF LONG JUMP PERFORMANCE

Astrit ISENI[1], Muamer ABDULLAI[2,3*]

[1]University of Tetova, Faculty of Physical Education – Tetova, North Macedonia
[2]Primary school "Zhivko Brajkovski" - Skopje
[3]Mother Teresa University – Skopje, Faculty of Social Sciences, Departaments of Sport Sciences
**Correspoding author e-mail: abdullaimuamer@gmail.com*

Abstract

In this study, the correlation and influence of morphological parameters and speed on the success of the long jump was investigated. The main aim of this study was to predict long jump performance based on morphological parameters and speed in male athletes. The research was conducted on a sample of 110 tester's aged 13 years ± 6 months, students of the "Bajram Shabani" elementary school - Kumanovo. A total of 9 variables were used in the research, of which: 6 variables for the assessment of morphological parameters (height, weight, body mass index, triceps adipose tissue, back adipose tissue, abdominal adipose tissue), 2 variables for the assessment of speed (running 60 meters, running 100 meters) and 1 variable for assessing situational-motor skills (long jump – collected technique). The highest correlation appeared between the variable 100 meter run (VR100m) and long jump performance (SMKGJ), with a negative value of -.453**. Multiple correlation revealed that the joint contribution of all independent variables to the evaluation of long jump performance is (R=549, R2=301), which indicates that 30.1% of long jump performance is derived from these variables. Of all the predictor variables tested in this paper, statistically significant influence on the dependent variable of the long jump (SMKGJ), there are only variables of the 100 meter run (VR100m), with a negative value of the standardized beta coefficient -.405 and with a level reliability 008.

Keywords: long jump performance, speed, morphological parameters, correlation, regression.

1. Introduction

Anthropological measurements are carried out with clear goals, to correctly see the profile and development process of the current state of students and athletes, concerning morphological characteristics, physical fitness abilities, functional abilities, cognitive abilities, conative characteristics, genetic aspects, and social status. The verification of the relationship and connectivity of the anthropological dimensions in students and athletes, and also in the situational-motor skills, which the curriculum in the field of physical education and health, should be supported based on scientific methodology. Morphological parameters and body composition have been described as determining factors in many performances of physical fitness skills, especially in jumping performance, where some studies have tried to categorize those morphological dimension variables that better explain jumping ability than the length of childhood and adolescence (Perez-Lopez, 2015:2). Vertical jumping is an important skill for assessing motor development during childhood and adolescence (Keiner, 2013: 1592). Body size has been proposed as an important factor in vertical jump performance during childhood and adolescence (Menzel, 2013: 1371), and several variables related to body composition are predictive of vertical jump performance such as: age, height, weight, and lean muscle mass (Aouichaoui, 2014: 7).

In teaching practice, especially among primary and secondary school children, there are researches of anthropological characteristics for increasing the efficiency of teaching work according to the individual abilities of students (Asllani, 2016: 45). In recent years, the relationships and influences of morphological

characteristics, physical fitness skills, conative characteristics, and cognitive skills in the success of students in achieving sports results in athletic disciplines - vertical jumps (Radic, 2008: 47) have also been researched. It has been proven that morphological parameters and motor skills are closely related to each other and that they affect the realization of most motor tasks and the resulting efficiency of educational program contents. Many researchers for the purpose have had the impact of a few-week program plan for the development of explosive strength in long jumps and triple jump, where after the realization of the experimental program plan they have achieved very positive results in terms of the development of sports performance in students and athletes in long jump disciplines (Asllani, 2007: 76). Some others have analyzed the impact of anthropological characteristics on professional athletes in long jumps during the Summer Olympic Games (Pavlovic, 2013: 64). Long jumps require great precision and perfect coordinated movements and psychophysical adaptive skills from the jumpers. The distance of the long jump depends on the magnitude of the initial flight speed, the angle, and the height of the body weight during the flight phase. From the biomechanical point of view, the length of the jump depends on these components: momentum, driving impulse, and swing with free extremities (Ameti, 2022: 223). In the discipline of the long jump, to achieve extraordinary success, in addition to the development of explosive strength as the basis of everything, it is also necessary to develop the performance of speed, endurance, and coordination (Jakoljevic, 2013: 151). Between the morphological structures, physical fitness skills are manifested, and this requires the need for these two spaces of anthropological characteristics to be treated together in parallel learning (Iseni, 2022: 33). This has influenced that in this paper some characteristics of the anthropological space (morphological and physical fitness) are researched in the function of the long jump athletic discipline, because they are not sufficiently researched among primary school students, especially among 13-year-olds. In addition, the teaching practice lacks basic scientific plans and programs for direct implementation, to remove the existing template in planning and programming work. We think that this research, when the influence between the morphological characteristics and the physical fitness skills of the students with the results in the athletic discipline in the long jump, will complete the fund of scientific knowledge for the needs of the efficient implementation of athletic content in physical education class.

2. Methods

2.1. Sample entities: The population sample was drawn from male students, aged 13 years ±6 months. The survey was conducted with 110 students, in the "Bajram Shabani" elementary school - Kumanovo (n=110; height 172.8, weight 67.9, BMI 22.7). The sample in this research is about morphological parameters, speed variables, and long jump performance. The results of this study will be obtained only from the participants who regularly attended physical education classes and participated in all tests.

2.2. Measurement variables and procedures: In the study, a total of 9 variables were used, of which 6 were for the evaluation of the morphological parameters, 2 for the evaluation of the speed, and 1 variable for the evaluation of the long jump performance. The variables for the assessment of morphological parameters are with numbers: 1. Body height (ABH), 2. Body mass (ABM), 3. Body mass index (ABMI), 4. Triceps adipose tissue (ATAT), 5. Back adipose tissue (ABAT), 6. Abdominal adipose tissue (AAAT), 7. 60-meter running (RU60m), 8. 100-meter running (RU100m), and 9. Long jump (Landing technique) (SMLJ). All measurements were performed on the same day under the guidance of researchers and support staff. Subjects were previously briefed on the best possible procedures for all testing to be performed effectively. Subjects then performed a 5-10 minutes warm-up and were allowed to practice 1-2 trials before the final trial. After each motor test, the participants had at least 10-15 minutes of recovery time.

Height, weight, and adipose tissue

Height and body weight measurements were performed with a digital scale (kg) and a stadiometer (cm). Adipose tissue was tested with the Caliper instrument (Seko USA), with an accuracy of 0.1 mm.

60 and 100 meters running

Each athlete was allowed two attempts and at the end, the best recorded time was recorded with an accuracy of 0.10 seconds. Speed tests were measured with the Microgate Witty timing system instrument.

Long jump performance

After the speed tests, the athletes performed the long jump performance. The testing was carried out in the special arena for the long jump in the "Sokollana"-Kumanovo athletics stadium. Each athlete had the right to take maximum momentum from 40 meters, while the long jump technique was the squat technique. With the help of the measuring tape in meters, the performance of the athletes was recorded.

2.3. Statistical analysis: Basic statistical parameters such as arithmetic mean, standard deviation, and distribution curves such as skewness curve (Skewnees) and roundness curve (Kurtosis) were calculated for all variables. Correlations with the Pearson method were also calculated to examine the relationship between anthropometric characteristics and speed tests with the assessment of long jump performance. Linear regression analysis as the multivariate analysis was set to predict the influence of predictor variables (anthropometric variables and speed) on the criterion variable (long jump performance). All results were calculated with the statistical program SPSS version 26.0.

3. Results

Table 1. Descriptive statistics of selected variables

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ABH	110	157.00	185.00	172.8318	5.77811	-.170	.230	-.632	.457
ABM	110	46.00	98.70	67.9518	10.54395	.427	.230	-.189	.457
ABMI	110	16.49	30.74	22.7148	3.23301	.576	.230	-.229	.457
ATAT	110	2.60	18.40	7.9145	3.36558	.832	.230	.288	.457
ABAT	110	3.40	19.30	7.5091	3.24409	1.590	.230	2.289	.457
AAAT	110	3.50	19.50	8.8809	4.51034	1.117	.230	.229	.457
RU60m	110	7.00	13.00	9.2364	1.19638	.738	.230	.565	.457
RU100m	110	13.10	19.70	15.4909	1.64398	.611	.230	-.533	.457
SMLJ	110	298.00	578.00	437.8273	79.74016	.281	.230	-1.205	.457
Valid N (listwise)	110								

In table 1, the main values and indicators of 13-year-old students are reflected. The main indicator of the dispersion of the results is the standard deviation. The values of the standard deviation are of a low level almost for most of the variables, i.e. that it is a question of homogeneous results, except for the variables body mass (ABM) and the variable of long jump performance (SMLJ), which results are of a high level, which i.e. it is about heterogeneous results, respectively results that have higher variability. The asymmetry of the curve is small in almost all variables, except for the curve of abdominal adipose tissue (AAAT) and back adipose tissue (ABAT), where the asymmetry is small and positive, which means that the results dominate positively. The value of the roundness of the curve for most variables is below 2.75, so all these values are platykurtic, which means that the results are distributed from the arithmetic mean.

Table 2. Correlations between the dependent variable (long jump) and the independent variables (morphological and speed)

Correlations

		ABH	ABM	ABMI	ATAT	ABAT	AAAT	RU60m	RU100m	SMLJ
ABH	Pearson Correl	1								
ABM	Pearson Correl	.407**	1							
ABMI	Pearson Correl	-.029	.898**	1						
ATAT	Pearson Correl	.122	.559**	.554**	1					
ABAT	Pearson Correl	.084	.627**	.646**	.609**	1				
AAAT	Pearson Correl	.112	.684**	.693**	.692**	.792**	1			
RU60m	Pearson Correl	.073	.130	.093	.170	.209*	.219*	1		
RU100m	Pearson Correl	.057	.173	.142	.258**	.231*	.212*	.809**	1	
SMLJ	Pearson Correl	.101	-.128	-.194*	-.304**	-.265**	-.266**	-.386**	-.454**	1

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

In Table 2, the correlations of the morphological and speed variables with the long jump performance variable are reflected. Correlations were tested for two levels of confidence p=0.01 and p=0.05. We can notice that out of a total of 36 possible correlation coefficients, 23 are statistically significant. The highest correlation value between anthropometric characteristics and long jump performance is presented between the variables triceps adipose tissue (ATAT) and long jump (SMLJ), with a negative value of -.304**. The highest correlation value between speed tests and long jump performance is presented between the variables 100-meter run (RU100m) and long jump (SMLJ), with a negative value of -.454. From this, we can conclude that the greater the value of the triceps adipose tissue and the greater the time of running 100 meters, the weaker the long jump performance result and vice versa.

Table 3. Summary model of multiple correlation between long jump performance and independent variables

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.549a	.301	.246	69.26162	.301	5.434	8	101	.000

a. Predictors: (Constant), RU100m, ABH, ABMI, ATAT, ABAT, RU60m, AAAB, ABM

Table 4. ANOVA table of linear regression model in relation to long jump performance and independent variables

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	208561.365	8	26070.171	5.434	.000b
	Residual	484514.353	101	4797.172		
	Total	693075.718	109			

a. Dependent Variable: SMLJ

b. Predictors: (Constant), RU100m, ABH, ABMI, ATAT, ABAT, RU60m, AAAB, ABM

Table 5. Regression coefficients of predictor variables on the dependent variable – (long jump)

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2755.104	1217.692		2.263	.026
	ABH	-11.395	6.973	-.826	-1.634	.105
	ABM	17.214	8.704	2.276	1.978	.051
	ABMI	-49.827	25.867	-2.020	-1.926	.057
	ATAT	-3.518	2.858	-.148	-1.231	.221
	ABAT	-1.212	3.476	-.049	-.349	.728
	AAAT	-1.659	2.885	-.094	-.575	.566
	RU60m	-3.238	9.699	-.049	-.334	.739
	RU100m	-19.634	7.257	-.405	-2.705	.008

a. Dependent Variable: SMLJ

From table 3, it can be seen that the multiple correlations between the dependent variable (criterion) long jump (SMLJ), as well as all other independent variables (predictors), is statistically significant R=(.549), respectively explains the common variability about 30.1% (R2=.301), while the other percentage 69.9% of the explanation of the variability of the common variables of the criterion variable (SMLJ) is used to other anthropological characteristics. From table 4, ANOVA of linear regression mode with long jump performance and independent variables we can see that the reliability level is sig=.000, which means that the value of variability between and within the group of the variance of the multiple regression has statistically significant differences. Of the predictor variables separately (table 5), the variable of running speed in 100 meters (RU100m) has the most statistically significant impact with a negative value of the standardized beta coefficient -.405 and a reliability level of .008.

4. Discussion

This study aimed to examine the correlations of long jump performance with anthropometric characteristics and speed in male athletes. The main finding is that there are significant relationships between long jump performance and anthropometric characteristics and speed. Many authors have found a relationship between morphological measures and vertical jumps, as well as sprint performance with jumps. The author (Asllani, 2014: 6) also found a significant correlation between the variables leg length and thigh circumference with long jump performance. The author (Bajçinca, 1999: 91) reported strong correlations between subcutaneous adipose tissue and the long jump, while among the motor variables high correlation with long jump performance has been achieved by the variables which are indicators of explosive strength. The author also found a statistically significant influence on the long jump variable (Idrizovic, 2008: 187), where the morphological variables of back fat tissue and calf circumference were the most important predictive variables. The author (Idrizovic, 2014: 27) also investigated the influence of motor variables in the long jump, where the best predictors were found to be the variables high jump from the place, triple jump from the place, 20-meter sprint, and 30-meter run. In a long jump, about ninety percent of the jump distance is the athlete's flight, horizontal distance, and speed, which has the highest effect on the flight distance among biomechanical factors. Therefore, especially the speed of the athlete in the last ten meters is considered to be the most important determinant of performance.

The author's research data (Bayrakter, 2018: 125) consisted of 328 valid trials in 73 male long jumpers of Turkish nationality, aged 18.7 (± 2.8) years. It was observed that sprint speed in the last ten meters explained 76% of the jump distance. Based on the estimation equation, it can be said that a 0.1 m/s increase in movement speed for long jumpers will increase their jump distance by 10.7 cm. It was observed that speed in the last 10 meters of the run was one of the most important predictors of performance. The author (Bar, 2011: 1977) found a significant correlation between long jump performance and 10-meter sprint. Mass, height and 50-meter sprint were shown to be very important predictors of long jump performance in the author's study (Mishra, 2016: 28). Significant relationships between speed and agility variables with long jump performances were also found in author (Singh, 2016: 24) and author (Sharma, 2014:50). Many tests of motor skills such as: balance test, flexibility test, lower extremity speed test, as well as coordination test had high correlation with long jump performance (Kastrena, 2019: 12). In conclusion, based on the obtained results, the following conclusions can be drawn: significant correlations were found between long jump and 100 meter running ($r=-454$, $p>.05$), significant correlations were found between long jump and running in 60 meter ($r=-386$, $p>.05$), significant correlations were found between the long jump and morphological variables triceps adipose tissue ($r=-334$, $p>.05$), abdominal adipose tissue ($r=-266$, $p>.05$) and back adipose tissue ($r=-265$, $p>.05$). In the regression analysis, the variable that strongly influenced the performance of the long jump is the predictor variable 100 meter run, from which we can conclude that speed is a very important indicator in achieving successive results in the performance of the long jump.

References

[1]. Ameti V., Iseni A. Memishi Sh. (2022). The effect of the plyometric program in the long jump and triple jump at student. Sport and Health, vol. 9/10, no. 17-18, pp. 222-228.

[2]. Aouichaoui C., Trabelsi Y., Tabka Z., Dogui M., Richalet J., Bouhlel E. (2014). Effect of anthropometric characteristics and socio-economic status on vertical jumping performances in Tunisian athletic children. American Journal of Sports Science and Medicine, 2 (1): 6-16.

[3]. Asllani I. (2007). Uticaj eksplozivne snage na rezultatsku efikasnost u daljinskim skokovima kod omladinaca. (The influence of explosive power on the result efficiency in long jumps in young people). (In serbian). Doctoral work, Faculty of Sports and Tourism– Novi Sad.

[4]. Asllani I., Kryeziu A., Rexhepi J., Bojaj I. (2014). Comparasion of morphological variables among 8th grade students of both genders in impetus long jumping performance. Activities in Physical Education and Sport, vol. 4,

no. 1, pp. 3-7.
[5]. Asllani I. (2016). Atletika (Athletics). Tetova.
[6]. Bajçinca Sh. (1999). Zgjidhja e kërcyesve në bazë të masave antropometrike dhe disa testeve motorike (Selection of jumpers based on anthropometric measures and some motor tests). Acta Kinesiologica, 6 (1): 90-97.
[7]. Barr MJ, Nolte VW. (2011). Which measure of drop jump performance best predicts sprinting speed? J Strength Cond Res, 25: 1976–1982.
[8]. Bayrakter, I. & Cilii, M. (2018). Estimation of jumping distance using run-up velocity for male long jumpers, Pedagogics-Psychology, Medical-biological problems of physical training and sport, 22(3): 124-129.
[9]. Idrizovic, K. (2008). Analysis of impact of morphological attributes on jumping disciplines in track and field. Sport Mont, VI (15-16-17), 182-188.
[10]. Idrizovic K., Nicin D. (2014). The selective battery of motor tests for a track and field event long jump. Sport Science and Health, vol. 4, issue 1, pp. 20-32.
[11]. Iseni A. (2022). Hulumtimet në sportet individuale – Atletika (Research in individual sports -Athletics). Tetova.
[12]. Jakoljevic V., Bosnjak G., Tesanovic G. (2013). Results analysis of athletic events 100m, high jump and long jump and their interconnectivity. Anthropological Aspects of Sports Physical Education and Recreation, 4 (1): 150-156.
[13]. Kastrena E., Suherman A., Ma'mun, A., Nugraha E. (2019). Correlation between Motor Ability and Long Jump Skills of Students. Advances in Health Sciences Research, vol 11, pp. 11-19.
[14]. Keiner M., Sander A., Wirth K., Schmidtbleicher D. (2013). Is there a difference between active and less active children and adolescent in jump performance? J Strenght Cond Research, 27 (6): 1591-1596.
[15]. Mishra MK, Rathore, VS. (2016). Speed and agility as predictors of long jump performance of male athletes. Turkish Journal of Sport and Exercise, vol. 18, issue 2, pp. 27-33.
[16]. Menzel HJ., Chagas MH., Szmurchrowski LA., Araujo SR., De Andrade AG., De Jesus FR. (2013). Analysis of lower limb asymmetries by isokinetic and vertical jump tests in soccer players. J Strength Cond Research, 27 (5): 1370-1377.
[17]. Pavlovič, R. et al. (2013). Differences in anthropological space of jumper's finalists of the Beijing Olympics. Research in Physical Education, Sport and Health, vol. 2, no. 2, pp.63-71.
[18]. Perez-Lopez A., Sinovas MC., Alvarez-Valverde I., Valades D. (2015). Relationship between body composition and vertical jump performance in young spanish soccer players. Journal of Sport and Human Performance, 3 (3): 1-12.
[19]. Radič Z., Simeonov A. (2008). Establishment of the latent structure of morphological characteristics and motor abilities and their relations with the long jump performance, Leka Atletika i Nauka, vol.1, no.10, pp.47-50.
[20]. Singh K., Singh R. (2016). Relationship of selected physical fitness variables with the performance of male long jumpers. International Journal of Physical Education and Sports, vol. 1, issue 1, pp. 23-27.
[21]. Sharma HO, Subramanian R. (2014). Speed and Agility as determinants of Long Jump Performance, Academic Sports Scholar, 3(9): 49-52.