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Professional paper

RELATIONSHIPS AND INFLUENCE OF ANTHROPOMETRIC CHARACTERISTICS AND PHYSICAL FITNESS PARAMETERS IN 100 M SPRINT RUNNING IN ADOLESCENTS

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Abstract

In this paper, we have searched the relationships and influence of anthropometric characteristics and physical fitness parameters in 100 meters sprint running in teenagers. The purpose of this paper is to prove the relationship between anthropometric characteristics and physical fitness parameters as a predictor system in the 100 meter sprint running as a criterion system. The research was carried out in 170 male subjects aged 14 years ± 6 months, in the primary schools "Bajram Shabani" and "Naim Frashëri" - Kumanovo, Rep. of North Macedonia. A total of 12 variables were used in the research, of which 7 variables were used for the assessment of anthropometric characteristics, including: body height, body mass, body mass index, chest circumference, thigh circumference, thigh fat and abdominal fatty tissue, 4 variables for evaluating physical fitness parameters, including: 10x5 Shuttle run, agility T-test, standing long jump and standing high jump, and 1 variable for evaluating speed, also: 100 meter sprint running. Based on the results obtained and the analysis carried out, we can conclude that: the variables of anthropometric characteristics and the parameters of physical fitness (as a predictor system) have a statistically significant impact on the in 100 meters running criteria variable, at the level of reliability q=.000. It's also worth noting that from the entire predictor system, the greatest individual impact on the 100 meter run criterion variable, have variables: standing long jump (MKGJV) with a negative beta coefficient value of -.330 and a reliability level of .000, T - agility test (MTT) with a positive beta coefficient value of .187 and a reliability level of .003 and 10x5 Shuttle run (10x5Sh) with a beta coefficient value of .150 and a reliability level of .032. From these results, we can conclude that adolescents of this age who have developed physical fitness parameters such as explosive strength of the lower limbs and speed with a change of direction – agility, achieve better results in 100 meters sprint running and also we recommend that the same tests be applied by athletics trainers to identify sprint running talent.

Keywords: anthropometric characteristics, physical fitness parameters, 100m sprint running, adolescents, regression.

1. Introduction

In this paper, we investigated the relationships and influence of anthropometric characteristics and physical fitness parameters in 100 meters sprint running in adolescents. The purpose of this paper is to prove the relationship between anthropometric characteristics and physical fitness parameters as a predictor system in the 100 meter sprint as a criterion system. However, in order to determine the structure and development of anthropometric characteristics in morphological space, solutions were sought in mathematical-statistical factor procedures, which isolated anthropometric characteristics, and which are determined by a set of manifest variables (anthropometric measures that can be measured directly) , as well as the latent morphological variables, which are not measured directly, because they are obtained by condensing

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(summarizing) the information obtained based on measured anthropometric measures (Iseni, A., 2022). The main method of sports anthropology, as well as of general anthropology, is the method of anthropometry, which is the measurement of a living person. Physical fitness is a state of health and well-being and, more specifically, the ability to perform aspects of sports, occupations and daily activities. Physical fitness is generally achieved through proper nutrition (Trembley, MS, 2010), moderate and vigorous physical exercise (de Groot, GC & Fargestrom, L., 2011), and adequate rest along with a formal recovery plan. Before the Industrial Revolution, fitness was defined as the ability to perform daily activities without excessive fatigue or lethargy. However, with automation and lifestyle changes, physical fitness is now considered a measure of the body's ability to function efficiently and effectively in work and leisure activities, to be healthy, to withstand hypokinetic diseases, to improve the function of the immune system and to meet emergency situations (Malina, R., 2010). Sprinting is running a short distance at higher body speed in a limited period of time. It is used in many sports that involve running, usually as a way to quickly reach a target or goal, or to avoid or catch an opponent. Human physiology dictates that the speed of a peak runner cannot be maintained for more than 30-35 seconds due to depletion of muscle phosphocreatine stores, and possibly secondarily to excessive metabolic acidosis as a result of anaerobic glycolysis (Hausbands, Ch., 2013). The genetic aspect plays a large role in the ability of athletes who cultivate sprinting, athletes must dedicate themselves to their training to ensure that they can optimize their performance (Lombardo, M.P. et al. 2014), (Scot, R.A. et al. 2010), (Eymon, N. et al. 2013). Sprint training includes various running exercises, sprint acceleration, speed development, speed endurance, special endurance and tempo endurance. In addition, athletes perform intensive strength training exercises, as well as plyometric exercises or jumps. Together, these training methods produce qualities that allow athletes to be stronger and more powerful, hopefully running faster. Speed is one of the most important motor skills, a necessary basis for all athletics disciplines, and not only hers, especially in short-distance running. Speed training begins before puberty at the age of 11-14 years which is characterized by the development of balance and functional maturation (Bompa, T., 2000) and genetic motor stereotypes pass to a higher degree of motor control (Bracic, M., et al. 2022). Anthropometric characteristics are of great importance in sports, but in athletics they are of peripheral importance in the selection of short-track runners. Also, measurements of anthropometric characteristics in athletes are the basis on which an important training process can be built (Misigoj-Durakovic, M., et al. 2005). But anthropometric characteristics, such as chest circumference, body height, thigh circumference, arm circumference, muscle mass and body fat percentage have a significant impact on sprinting (Pelemis, V., et al. 2014). Based on this, the main objective of the research is to determine the relationships and influence of anthropometric characteristics and physical fitness parameters in sprinting 100 meters in teenagers.

2. Methods

Participants

The sample of entities was drawn from male students, aged 14 years ±6 months. The research was carried out in 170 subjects, in the primary schools "Bajram Shabani" and "Naim Frashëri" - Kumanovo. The population sample in this study is non-selective in relation to anthropometric characteristics and physical fitness parameters, namely 100 meter sprinting. The results in this research will be obtained only from the test subjects who regularly attended the physical education classes and participated in all the tests. The research was approved by the Ethics Committee of the Faculty of Physical Education, University of Tetovo (February 20, 2021 with protocol number 0129/12), in accordance with the Declaration of Helsinki (World Medial Association, 2013).

Sample variables

In the research, a total of 12 variables were used, of which 7 for the assessment of anthropometric characteristics and 4 for the assessment of physical fitness skills or predictor parameters and 1 variable for the assessment of running in 100 meters or criterion variable. The variables for the assessment of anthropometric characteristics are: body height (BH), body mass (BM), body mass index (BMI), chest circumference (CC), thigh circumference (TC), thigh fat tissue (TFT) and abdominal fat tissue (AFT), the variables for assessing physical fitness skills are: 10x5 Shuttle run (10X5Sh), T-test agility (T-test), standing long jump (SLJ) and standing high jump (SHJ), while the variable for the evaluation of the specific-motor ability is the only criterion is the 100 meter run (R100m).

Data processing

In order to prove the influence and relations between the anthropometric variables and physical fitness as a predictor system and the 100 meter run variable as a criterion system, regression analysis or methods for the analysis of the influence and relation were applied which are included in the group of multivariate analyses. In the following tables, we have shown the results of the basic statistical parameters of the predictor variables and criteria or measures of central tendency and dispersion for each indicator: the minimum score, the maximum score, the arithmetic mean, the standard deviation and the main distribution indicators asymmetry (skewness) and tailedness (kurtosis). We have also shown the correlations of anthropometric variables and physical fitness with the variable of running 100 meters, as well as regression analysis tables. For data processing, we applied the statistical package SPSS 26.0.

3. Results

Table 1. Basic statistical parameters of anthropometric characteristics, physical fitness and 100-meter running

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
BH	170	148.00	183.00	169.4035	7.72154	-.610	.186	.271	.370
BM	170	34.00	96.00	59.8353	**11.28014**	.602	.186	.359	.370
BMI	170	14.70	30.50	20.8024	3.44868	.871	.186	.311	.370
CHC	170	64.20	106.00	84.2853	7.51402	.370	.186	.134	.370
THC	170	35.50	62.00	48.0182	5.13292	.223	.186	-.160	.370
TFT	170	5.30	31.20	12.0994	4.55127	.964	.186	.988	.370
AFT	170	3.30	25.40	10.2035	4.51050	**1.041**	.186	.600	.370
10X5Sh	170	15.47	27.40	19.9941	2.06854	.512	.186	.659	.370
T-TEST	170	6.40	11.14	8.0608	.85280	.450	.186	.699	.370
SLJ	170	120.00	260.00	186.6365	**26.59879**	-.118	.186	-.223	.370
SHJ	170	20.00	62.00	39.3294	7.98058	.043	.186	-.308	.370
R100m	170	12.36	19.76	15.0972	1.60200	.407	.186	-.565	.370

In table 1, the main values and indicators for men aged 14 are reflected: the minimum score, the maximum score, the arithmetic mean as central indicators, the standard deviation as the main dispersive indicators, as well as the main indicators of the shape of the distribution curve, asymmetry of the curve (skewness), as well as roundness of the curve (kurtosis). From these data, it can be observed that the average value of the body mass index BMI is 20.802 percentile, which means that in this age group we do not have overweight, but it is a matter of normal nutrition units, eventually in some students we have overweight or any rare case of marked overweight-obese unit. The standard deviation values are low for all the investigated variables, which means that it is a matter of homogeneous results, except for the variables standing long jump (SLJ) and body mass (BM), where the results are in a higher level, which means that it is a question of heterogeneous results, respectively results that have higher variability. The asymmetry of the curve is small for almost all variables, and for some even with negative values. The value of the roundness of the curve for all variables is below the value of 2.75, so that all these values are platykurtic, which means that the results are distributed from the arithmetic mean.

Tabela 2. Intercorrelations between anthropometric characteristics, physical fitness and 100-meter sprint

Correlations

	LT	MT	IMT	PKGJ	PKO	IDHKO	IDHB	10X5Sh	T-Test	KGJV	KLV
BH	1										
BM	.483**	1									
BMI	.019	.881**	1								
CHC	.313**	.881**	.847**	1							
THC	.276**	.837**	.816**	.753**	1						
TFT	-.072	.549**	.671**	.492**	.528**	1					
AFT	-.034	.592**	.709**	.564**	.544**	.768**	1				
10X5Sh	-.165*	.105	.199**	.114	-.009	.278**	.247**	1			
T-TEST	-.207**	.091	.211**	.094	.019	.274**	.242**	.631**	1		
SLJ	.367**	-.101	-.302**	-.119	-.041	-.480**	-.362**	-.598**	-.502**	1	
SHJ	.425**	.008	-.215**	-.049	.033	-.400**	-.278**	-.540**	-.411**	.740**	1
R100m	-.419**	.066	.293**	.086	.030	.432**	.368**	.601**	.574**	-.729**	-.641**

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

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

Correlations between variables were tested for two levels of reliability: p=0.01 and p=0.05. In table 2, the coefficients of intercorrelations for all variables are reflected in the results of males aged 14 years. Correlations with high values have appeared between the variables: body mass (BM) correlates with body mass index (BMI), with a value of .881** (**-this sign represents the confidence level p=0.01, while this sign * confidence level p=0.05), body mass (BM) correlates with chest-thigh circumference (TBC), with a value of .881**, body mass index (BMI) correlates with chest-thigh circumference (TBC), with a value of .847**, body mass (BM) correlates with thigh circumference (THC)), with a value of .837**, body mass index (BMI) correlates with thigh circumference (THC)), with a value of 816 **, thigh adipose tissue (TFT) correlates with abdominal adipose tissue (AFT), with a value of .768**, chest thigh circumference (CHC) correlates with thigh circumference (APKO), with a value of .753**, standing long jump (SLJ) correlates with standing high jump (SHJ), with a value of .740**, standing long jump (SLJ) correlates with the 100 meter run (R100m), with a value of .729** and body mass index (BMI) correlates with abdominal fat tissue (AFT), with a value of .709**. There are also correlations where their values have statistically significant values between these variables: (BMI) and (TFT) with a value of .671**, (SHJ) and (R100m) with a value of -.641**, (10X5Sh) and (T-Test) with a value of .631**, (10X5Sh) and (R100m) with a value of .601**, (10X5Sh) with a value of -.598**, (BM) and (AFT) with a value of .592**, (T-Test) and (R100m) with a value of .574**, (CHC) and (AFT) with a value of .564**, (BM) and (TFT) with a value of .549**, (THC)) and (AFT) with a value of .544**, (THC)) and (TFT) with a value of .528**, (T-Test) and (SLJ) with a value of -.502**, (CHC) and (IDHKO) with a value of .492**, (BH) and (BM) with a value of .483**, (TFT) and (SLJ) with a value of -.480**, (TFT) and (R100m) with a value of .432* *, (BH) and (SHJ) worth .425**, (BH) and (R100m) worth -.419 and (T-Test) and (LV) worth -.411**. Correlations of variables are also presented in this table, where their coefficients also have low values and some correlations with insignificant statistical values, for this reason we will not comment on them at all.

Table 3. Regression correlation between motor variables and physical fitness with the criterion variable 100 meter run

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.807[a]	.651	.626	.97939	.651	26.743	11	158	**.000**

a. Predictors: (Constant), MKLV, AMT, MTT , ALT, M10X5, AIDHB, MKGJV, AIDHKO, APKO, APKGJ, BMI

Table 4. Regression analysis of the 100 meter run variable (Coefficients)

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	26.009	10.512		2.474	.014
	BH	-.065	.063	-.311	-1.019	.310
	BM	.051	.089	.358	.573	.567
	BMI	-.089	.273	-.191	-.325	.746
	CHC	-.018	.023	-.085	-.780	.437
	THC	-.015	.030	-.048	-.500	.618
	TFT	.016	.029	.047	.559	.577
	AFT	.031	.029	.087	1.049	.296
	10X5Sh	.116	.054	**.150**	2.160	**.032**
	T-Test	.352	.117	**.187**	2.997	**.003**
	SLJ	-.020	.005	**-.330**	-4.097	**.000**
	SHJ	-.022	.015	-.110	-1.468	.144

a. dependant variable: VR100m

From table 3, it can be seen that the multiple correlation between the dependent variable, in this case the 100 meter run (R100m), as well as all other independent (predictor) variables is statistically significant (0.0807), respectively, it explains the variability of common about 65.1% (R2=0.651), while the other percentage 34.9% of the explanation of the common variability of the criterion variable (R100m) belongs to other anthropological characteristics (morphological, motor, conative, cognitive, social, etc.). The reliability level p=0.000 shows that the value of the variability between and within the group of the variance of the multiple regression has a statistically significant difference, so it is of interest to comment on the influence of the predictor variables separately on this ability.
In table 4, the standardized beta coefficients with the impact values on the criterion variable (R100m) are reflected. From this, it can be seen that the highest impact on this ability has the variable standing long jump (SLJ), with a value of -.330 and a reliability level of .000. But since this value has a negative sign, it means that the influence of this variable is negative. The T-test (TT) variables also have a higher positive influence, where its beta coefficient is .187, with a reliability level of .003, and the 10x5 shuttle run (10X5Sh) variable, where its beta coefficient is .150, with a reliability level of .032.

4. Discussions

In this study, the main goal was to verify the influence of anthropometric variables and physical fitness parameters as predictor variables, on the criterion variable of sprinting in 100 meters (R100m). From the examination of the results, it was proven that the anthropometric variables and the physical fitness parameters have a statistically significant impact on the criterion variable sprint running in 100 meters (R100m). Authors Piennar and Kruger (2009) investigated the influence of anthropometric characteristics and motor performance on sprinting and long jumping in children aged 10-15 years. The most talented subjects (N = 39) were selected from 66 boys by means of a Talent Search testing protocol and then underwent a sport-specific test battery consisting of five anthropometric and 16 physical and motor variables. The results showed that mean anaerobic power output, acceleration, body mass, reaction time, iliopsoas flexibility, speed endurance, sitting height, and age contributed 86.5% of the total variance in 100-meter sprint performance. Iseni (2013) has investigated the influence of motor skills on the success of sprint runs in 20 and 60 meters. The research was conducted on a sample of 40 male subjects aged 10-14 years in the Teuta-Kumanovo karate club, North Macedonia. The author concluded that karate athletes who possess the most advanced level of basic motor skills, defined as explosive strength, speed, mobility and flexibility, will achieve better results in the 20 and 60 meter sprints. Ciliik et al. (2013) investigated the influence and correlation between speed and speed endurance tests in sprint running in young sprinters. The research was carried out on a sample of 7 athletes, aged 14, members of an athletic club in Slovakia. The results showed that sprinters performed better in speed than middle and long distance runners, while poorer in speed endurance tests. Stojanovic, J. et al. (2014) investigated the influence of basic and specific motor skills on 60m sprint performance. The research was conducted on a sample of 30 high school students in the city of Paraqin - Serbia.
The results of the regression analysis showed that there is a statistically significant influence between the predictor variables on the criterion variable sprinting in 60 meters, of which the

specific-motor variables, long jump with weights and sprinting in 300 meters have shown the most important influence , while from the basic-motor variables, long jump from the place and running in 20 meters. Malaydi, H. & Indah, D. (2019) applied explosive strength development program to 100m sprint running in 14 students aged 14 years, and concluded that explosive strength development program has a significant impact statistical effect on 100-meter sprint performance and starting acceleration in sprinters. Iseni et al., (2020) investigated the influence of motor skills on the success of sprint runs in 30 and 80 meters. The research was carried out on a sample of 170 male students aged 14, primary school students in the city of Kumanovo - North Macedonia. The interpreted results lead to the conclusion that between the predictor system and the criteria variables sprinting at 30 and 80 meters, there is a correlation with statistical significance, where the variables with foot taping have shown the greatest individual influence on the criteria variables running at 30 and 80 meters. on the wall, the variable of eight-fold agility and the T-test variable, which i.e. that the variables for the evaluation of segmental speed and agility, have a high influence on the success of the results in sprint runs at 30 and 80 meters. Ameti. et al., (2013) investigated the influence of motor skills and anthropometric characteristics on the success of the 400 meter sprint. The research was carried out on a sample of 130 test subjects, students aged 16 years. A total of 26 variables were used in this research, including: 13 variables for the evaluation of anthropometric characteristics, 12 variables for the evaluation of motor skills and 1 variable for the evaluation of sprint running in 400 meters. The authors concluded that the variables: foot tapping, standing long jump, and arm fat had the most statistically significant influence on the 400-meter run variable. Asllani, I. & Iseni, A. (2014) investigated the correlation and influence of anthropometric characteristics on the success of sprinting in 400 meters. The research was conducted on a sample of 100 examinees, aged 15. A total of 14 variables were used in the research, of which 13 variables were used for the assessment of anthropometric characteristics and 1 variable for the assessment of sprint running in 400 meters. Based on the results obtained from the correlation analysis, it can be concluded that only 2 variables have low-level correlations with the 400-meter running variable, that too: arm adipose tissue and back adipose tissue. While based on the results obtained from the regression analysis, it can be concluded that a total of 3 variables have a statistically significant impact on the criteria variable running in 400 meters: back fat tissue, sitting height of the body and height of the body. Iseni, A. and authors (2016) investigated the influence of functional abilities on sprint runs. The sample of respondents consisted of 100 high school students in the municipality of Likova-North Macedonia, aged 15 years. For the assessment of functional abilities they used the following tests: pulse frequency at rest, pulse frequency after load and the vital capacity of the lungs, while for the assessment of sprint runs they used the tests, running in 200 and 400 meters. Based on the results of the regression analysis, it can be concluded that the functional skills variables as a predictor system have a statistically significant impact only on the 400 meter run variable, where the pulse frequency variable after the load has the most significant impact. Yousif, A. H. Et al., (2019) investigated the influence of some physical fitness skills on 400-meter sprint running and tracked the recovery phase of the lower extremity muscle group using electromyography. The authors concluded that the recovery phase had a more important impact on sprint running than the impact of physical fitness performance.

5. Conclusions

Based on the obtained results and the performed analysis, we can come to the conclusion that: The variables of anthropometric characteristics and physical fitness used as predictor variables in this paper have statistical significance in the criterion variable of running 100 meters (R100m). Greater correlation with the 100 meter run (R100m) from the physical fitness variables have been shown by the long jump from the place (SLJ), T-test agility (TT) variables and 10x5 shuttle run (10x5Sh) variables which express explosive strength, speed and agility with a change of direction. From these results, we can conclude that students of this age who possess motor skills such as explosive strength, speed and speed with a change of direction, will achieve better results in the 100 meter sprint where explosive strength and speed are expressed. From here we can recommend to all coaches and pedagogues who cultivate running on short paths or more specifically sprinting, to practice these types of physical fitness tests in their training programs, and also practice these tests during selection of young talents.

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