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THE BODY HEIGHT AND WEIGHT INFLUENCE ON MOTORIC ACHIEVEMENTS TESTS PERFORMING IN BASKETBALL FOR THREE DIFFERENT AGES

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Abstract
The aim of this research was to determine body weight and height influence on motoric achievements tests performing in basketball for three different ages. In this study 216 participants had been included, they were devided in three subsamples (70 students in both 6th and 9th junior highschool grades and 76 students in 3rd hightschool grade). Motoric achievements tests in basketball have determined achievements for techniques of catching and passing, dribbling and shooting on basket. Obtained results have shown that for youngest subsamples body height influences catching and passing in a set position test. In 9th grade body height and weight influence shooting on basket in 30 second test, while influence of body weight we can notice in catching and passing in a set position test. On samples results in 3rd highschool grade body height influence has been determined only in shooting on basket in 30 seconds test. In other tests there has not been determined any influence of predicate set of variables on test performing.A small precent of mutual variability, which describes predicate set of variables, shows that on successful performance of motor achievements tests some other anthropomotoric measures have influenced, as well as some other anthropological features, what was confirmed by other researches.

Key words: **shooting on basket, catching and passing, regression analysis, body height and weight**

Introduction

According to the structural complexity criterion basketball is one the most complex sport that includes simple or complex movements, which are performed by team members in coopertional conditions (Rađo, et al., 2000). The ball techniques in basketball are manifested by application of different ways of passing, dribbling and shooting to the basket.The performing of listed techniques requires ability of coordination to connect movements, ability of differentiation as well as balance (Meinel, et al., 2004). However, it is important to point out that the ball technique in basketball represents constant upgrading of biotical-motoric knowledge of ball throwing, catching, passing as well as dribbling (Sekulic, et al., 2007).
Basketball particularities, its popularity among students have already been recognized, as a result of that basketball has become an inherent part of school sport and physical education classes. Different anthropological characteristics have influenced movement structures performances in basketball as well as achievment in basketball itself. There is very important influence on successful movement structures performances in basketball by morphological characteristics too (Jašarević, et al., 2013; Aruković, 2013). Human beings have been experiencing different growing and developing phases during their lives. During the school ages those phases have a really strong influence on complete anthropological status of each individual (Meinel, et al., 2004). Tested subsamples expereince three growing periods:pre-puberty,6th grade, puberty, 9th grade and period of adolescence, 3rd highschool grade (Meinel, et al., 2004; Mikić, 2000; Neljak, 2013). Therefore the aim of this work is to determine the level in which body height and weight influence motoric achievements in basketball in different developing periods.

Methods

Sample

This research has been done with three male subsamples: 6th and 9th junior highschool grade and 3rd highschool grade. Subsample of 6th and 9th grade has 70 each and 3rd highschool grade has 76 subjects. Subsample of the

6th grade is: (11 years (+/- 6 months) old with body height:1,55±0,08m; body weight: 46,10±11,28kg). Subsample of the 9th grade is: (14 years (+/-6months) old with body height:1,76±0.09m; body weight: 61,95±13.17kg). Subsample of the 3rd hightschool grade is: (17 years (+/- 6months) old with body height:1,81± 0.06m; body weight:73.80±10.55kg). Subjects are regular students of physical education classes. Beforehand endorsment for participating in this research for all subjects has been given by their parents.

Sample of variables

This research has been determined on set of five variables by which motoric achievements in basketball have been evaluated. Before conducting this research metrical test characteristics have been determined. For this research the tests for estimating motoric achievements in: catching and passing in a set position and movement, dribbling and shooting on the basket have been used. Besides those tests, body height and weight have been estimated as well. Tests description for motoric achievements estimation in basketball:

Catching and passing in a set position – The junior highschool participant stands 2.5 m far from the wall, while 3rd highschool grade participant stands 3m far from the wall. On the sign for 30 seconds participants should do chest passing with both hands towards the wall. After 30 seconds, if ball falls before the test end we write down the result. Test should be done for three times.

Dribbling in slalom – The participant on the sign"now" goes around the flags, between the flags there is 3m distance,with dominated hand he goes back to the start line.We write down the time when the participant reaches the starting line.The participant must not miss the flag and change his hand while dribbling.We write down the time in two decimals, test should be done for three times.

Shooting on basket in 30 seconds - The participant stands under the basket. Hearing the sign"now" he shoots on the basket. He should score as much as possible number of points. The participant takes the ball after each shot. We write down the number of scored points. The test should be done for three times.

Catching and passing in a movement – The participant stands on a line which is 2.45m far from the wall.There are six squares each 60cm big on the wall.The squares are arranged in a row; first one is at a height of 1.5 m from the ground, second one at 0.9m, third one at 1.5 m, fourth one at 0.9 m,fifth one at 1.5 m and sixth one at 0.9 m. The participant hearing the sign "now" tries to hit squares as they are arranged using chest passing technique in a row and double step. After reaching the last square he hits it for two times and goes back. The test should be repeated within 30 seconds. We write down only hit squares and each is one point worth. The test should be done for three time.

Shooting from different positions in 60 seconds – The test should be performed from five different positions which are far from the basket: 2.75m for the 6th grade, 3.60m for the 9th grade of junior highschool and 4.75m for the 3rd highschool grade. First position is perpendicular to the basket in the free-throw line direction, second and third ones are at 90° and fourth and fifth are at 45°. The participant hearing "now"starts shooting from the first position, than from second or third one (free choice) and finishes from fourth or fifth (free choice). Free choice will be determined by ball bouncing. The sequel is repeated within 60 seconds. The participant who scores from some of the positions has an extra shoot under the basket. Each scored point is one point worth. Test should be done for three times.

Statistical analysis

For all variables mean, standard deviation and Kolmogorov Smirnov test have been counted. Reliabilty assessment of all tests has been counted by Cronbach alfa. Body height and weight influence on motoric achievements tests performing have been determined by standard regression analysis. Listed tests will represent criterion variable, while predictor set of variables will represent body height and weight

Results

Table 1. Central and dispersive parameters and reliability of tests for estimating motoric achievements in basketball (Class- VI -6th; IX- 9th; IIIHS- 3th High School;M- mean, SD- standard deviation,K_S-Kolmogorov Smirnov test and Crα – Cronbach alfa)

Class	Variables	M	SD	K_S	Crα
VI	OKBLRZ	18,69	6,74	0,15	0,95
	OKVLS	10,38	1,23	0,09	0,92
	OKBLK	4,17	2,08	0,13	0,89
	OKBLRK	17,58	3,59	0,11	0,97
	OKSRP	2,51	2,00	0,11	0,89
IX	OKBLRZ	26,52	4,89	0,14	0,89
	OKVLS	9,50	1,10	0,14	0,94
	OKBLK	7,36	3,69	0,12	0,95
	OKBLRK	20,48	3,83	0,08	0,96
	OKSRP	3,10	2,14	0,09	0,86
IIIHS	OKBLRZ	28,26	2,72	0,10	0,91
	OKVLS	8,95	0,92	0,08	0,88
	OKBLK	11,71	3,69	0,09	0,94
	OKBLRK	24,27	3,69	0,09	0,97
	OKSRP	4,68	2,69	0,11	0,88

Legend:Catching and passing in a set position in 30sec,(OKBLRZ), Dribbling in slalom(OKLVS), Shooting on basket in 30s(OKBLK),Cathcing and passing in a movement in 30 sec (OKBLR), and Shooting from different position in 60s (OKSPR).

According to the average value results in table no.1 we can notice that there has been result improvement with aging of subsamples in each tested variables. Standard deviation of achieved results shows that the highest values have been determined at catching and passing in a set position, which have been decreased by aging. In tested variables

the lowest value of standard deviation has been noticed at dribbling in slalom test. Results of standard deviation should represent 1/3 of mean in order to make difference between participants (Malacko et al., 2001). Based on the obtained results we can notice that in throwing on the basket from different position test there is a high value of standard deviation in relation to the subsamples average achieved results. To determine normality of distributed data for testing of variables the Kolmogorov Smirnov test has been evaluated. Obtained results have shown that there is a normal result distribution in each tested variables and subsamples. Before the regression analysis implementation, reliability of measured instruments for each subsample has been determined in order to estimate whether the tests have defined object of measurement or not. Acceptable values of Cronbach alfa should not be lower than 0.70 (Pallant, 2011). Values of Cronbach alfa (Crα) are above (Crα >0.85) so we can notice high level of reliability.

Table 2. Body height and weight regression analysis influence on performance of motoric achievements tests in basketball (B-standardized beta coefficient, p-significance value , Ro-multiple correlation and Ro2 - determination coefficient)

Variables	Class	Predictors	B	p	Ro	Ro^2
(OKBLRZ)	VI	Height	**0,49**	**0**	,43**	0,18
		Weight	-0,11	0,46		
	IX	Height	0,01	0,95	0,34*	0,11
		Weight	**0,33**	**0,05**		
	IIIHS.	Height	0,03	0,83	0,28	0,08
		Weight	**0,27**	**0,03**		
(OKVLS)[1]	VI	Height	-0,18	0,28	0,21	0,04
		Weight	0,29	0,08		
	IX	Height	-0,25	0,16	0,2	0,04
		Weight	0,07	0,69		
	IIIHS.	Height	0,06	0,62	0,12	0,01
		Weight	-0,13	0,33		
(OKBLK)	VI	Height	0,3	0,06	0,24	0,06
		Weight	-0,12	0,47		
	IX	Height	0,31	0,06	0,43**	0,18
		Weight	0,15	0,36		
	IIIHS.	Height	**0,26**	**0,04**	0,33*	0,11
		Weight	0,14	0,25		
(OKBLK)	VI	Height	0,28	0,08	0,22	0,05
		Weight	-0,11	0,5		
	IX	Height	0,07	0,68	0,14	0,02
		Weight	0,08	0,65		
	IIIHS.	Height	-0,07	0,58	0,11	0,01
		Weight	0,12	0,35		
(OKSRP)	VI	Height	0,26	0,11	0,25	0,06
		Weight	**-0,34**	**0,04**		
	IX	Height	0,1	0,57	0,13	0,02
		Weight	0,04	0,82		
	IIIHS.	Height	0,1	0,42	0,1	0,01
		Weight	-0,03	0,79		

Legend:[1] (-) negative coefficient indicates to oposite scaling in dribbling tests;
Legend: Significant level * = 0.05 and **= 0.01
Legend: Catching and passing at a set position in 30sec **(OKBLRZ),** Dribbling in slalom (OKVLS), Shooting on basket in 30s (OKBLK), Catching and passing in a movement in 30sec(OKBLRK) and Shooting from different positions in 60s**(OKSRP)**

In order to determine body height and weight influence on performance of motoric achievements tests standard regression analysis has been used. Based on obtained results we can notice that in some tests and subsamples statistically significant regression models have been determined, therefore we can conclude that predictor set of variables influences performance of some tests for estimating motoric achievements in basketball.

In (Table 2) results of regression analysis, with a catching and passing in a set position as a criterion variable,show that subsample of 6th grade has had, according to the F test, statistically significant regression model , in other words there is statistically significant relation between criterion and predicate set of variables. Multiple correlation coefficient (Ro) is (Ro=0.43**) what explains about 18% (Ro^2=0.18) of mutual variability. The rest of variability can be attributed to other anthropological participants features. Based on the analysis of the influence of predicate set of variables we can conclude that body hight has statistically significant influence (B=0.49, p=0.00). Statistically significant regression model has the same statistical importance for subsample in 9th grade. Multiple correlation coefficient (Ro) between predicate set of variables and criterion variable is (Ro=0.34*) what explains about 11% (Ro^2=0.11) of mutual variability. Based on the analysis of the influence of predicate set of variables we can conclude that body weight has statistically significant influence (B=0.33, p=0.05).

There hasn`t been determined any statistically significant regression model on performance of catching and passing in tested subsample in 3rd grade of high school, therefore other anthropological characteristics have influenced that performance. Existing of statistically siginificant beta coefficient in predicate variable for body weight has been considered as coincidence which is difficult to explain meaningfully (Malacko, et al.,2001).

Standard regression analysis in which the body height and weght influence has been determined in dribbling in slalom test performing, statistically significant regression model in tested subsamples hasn`t been confirmed.

By analyzing of body weight and height influence on shooting on basket in 30 second test, statistically significant regression model in tested subsamples of 9th junior high school and 3rd high school grade has been confirmed. Multiple correlation coefficient (Ro) is (Ro=0.43**) in 9th junior highschool grade and (Ro=0.33*) in 3rd high school grade .Determination coeffiecient (Ro^2) in 9th grade explains 18% (Ro^2 =0.18), and in 3rd grade 11% (Ro^2 =0.11) of mutual variability criterion of variable .

Based on analysis of some variables in predicate set we can notice that in 9th grade there are no statistically significant beta coefficients. In situations when there are no statistically significant beta coefficients in predicate set of variables, but when there is statistically significant multiple correlation coefficient we can conclude that whole predicate set influences criterion variable explanation (Malacko, et al. 2001). In 3rd high school grade there has been determined that there is statistically significant influence of body height (B=0,26, p=0.04) on shooting on basket in 30 seconds test.

By analyzing of body weight and height influence on catching and passing in movement test it is noticable that there is no statistically significant regression model in any of tested subsamples, apropos it there are other anthropological features that influence test performing.

After examining regression analysis results, where we have determined body weight and height influence on performing of shooting on basket from different positions in 60 seconds test, we can notice that there was not possible to determine existence of statistically significant connection between predicate set of variables and criterion variable. However, based on standard regression beta coefficients it is noticable that for subsample of 6th garde body weight (B=-0.34, p=0.04) has statistically significant beta coefficient. In the case that in regression analysis there is no statistically significant regression model, but some variables in predicate set have statistically significant beta coefficient, we should consider that case as a coincidence that is difficult to interpret (Malacko, et al.2001).

Discussion

By basic descriptive results analyzing of body height and body weight there can be noticed slight growth of both tested features at older junior high school age in comparison with younger one. However, in comaprison with high school age growth of body height is lower, while growth of body weight is on a par with body mass between younger and older junior high school age. Dynamics of lower growth of body weight and height in pre- puberty, as well as sudden growth in puberty time, lower growth of body height during adolescence time and similar growth of body weight between tetsed subsamples is in accordance with determined theoretical and practical knowledge in this researching field (Neljak, 2013).

In equation of specifications achievement in sport, anthropometric characteristics have significant influence on achieving success in sport. Different methodical tasks demand special morphological type for achieving good results (Ivanovic, et al., 2015). International biological program has 39 anthropometric measures (Malacko, et al.,2001). Therefore, we can conclude that body height and weight cannot represent whole set of measures.

However, in order to find the answer why certain results have been obtained, it is necessary to be familiar with structure and relation of some subsystems. Some researches conducted in order to get structure of morphological space have determined that there is relation between certain anthropometric measures, which are significant but incomplete (Mavrić, et al., 2005; Kapidžić, 2007; Bajrić, et al., 2011; Ivanović, et al., 2015). Hence, we can directly conclude that positive influence of body height and weight on performing of certain motoric achievements tests is not only result of them and as well as due to its correlation with other anthropometric measures. There has been determined that body height has

significant correlations with body weight, length of limbs, hands width; while body weight significantly correlates with extent of upper arm, extent of lower leg, hands width and measures for determining skinfold (Mavrić, et al., 2005; Kapidžić, 2007; Bajrić, et al., 2011; Ivanović, et al., 2015).

Before analysing influence of body height and weight on performing motoric achievements tests it is necessary to realize that regression models, which are statistically significant, clears up small amount of variability and therefore an influence on achievement of performing has other anthropological characteristics as well as the level of motoric knowledge of certain movement structure .

Connection between body structure and success in sport has its roots in biomechanical aspects or mechanical legality, which determine energy transfer to the gadget and certain part of body (Schnabel, et al., 2005). Higher body height enables ball throwing from higher position as a result of it there is less strenght usage if we want to throw a ball to the same distance. Since in the catching and passing test in a set position distance has been determined, taller persons are in advantage because they don`t need so much energy to throw a ball and ball falls from the higher place. Therefore it has been expected that at youngest subsample body height impacts test performaning. In research with the junior high school subsample has gotten the same result, taller students achieve better results in catching and passing test at the set position in 30 seconds (Aruković, 2013), while with highschool subsample research has not confirmed body height impact on test performing (Jašarević, et al., 2013).

In accuracy tests in basketball, there has been determined a positive body height influence at older junior highschool and high school subsamples in shooting for 30 seconds under the basket test. Positive influence has been expected due to subsample position under the basket. There is less missing chances due to higher height, and closeness to the basket. In some researches similar results has been obtained with the same subsamples (Jasarevic, et al., 2013; Arukovic, 2013). We should emphasize that if we would like to determine body height influence on test performing, samples should have a certain height, therefore it is normal if there is no body height influence on test performing for junior highschool sample.

At higher height there has been determined body weight influence on catching and passing in a set position test. Body mass, besides importance of active body mass for potencial strenght has significant impact for energy transfering on a gadget, in our case ball, during the throw-out (Schnabel, et al., 2005). By examininig of body weight influence on motoric achievement tests in basketball we can notice for subsample of 9th junior highschool there has been a positive body weight influence for tests like catching and passing as well as shooting on basket under the basket. On achieving of better results in ball catching and passing in a set position test at older junior high school students coorelation between body mass and others morphological features, among others fist widht,volume of upper arm have significant influence (Ivanović, 2015). Possibility of better ball catching due to bigger fist width, upper arm volume which indicates increase of muscle mass creates assumption for more repetitions. However, body weight influence on shooting on basket in 30s test can not be seperated from body height influence, because of mutual influence on performing success. Expetation that higher growth of body mass will contribute to better results had been omitted, what was shown by results analazing of subsamples in high school, where body mass influence has not been determined in listed tests.

Significant influence of body weight has been determined in catching and passing in 30 seconds test for high school age (Jašarević, et al., 2013).

In dribbling in slalom test in basketball there has been determined a lack of body height and weight influence on successful performing for the tests which require body movement. Similar results have been obtained for high school age, there is no body weight and height influence on successful performing of the same test (Jašarević, et al., 2013).

In catching and passing tests in movement and shooting on basket from different positions in 60 seconds test there has not been determined any influence of predicate set of variables on test performing. For listed tests as well as for dribling in slalom test, with successful task performing, besides motoric knowledge, body movement in space has been required what will be contributed for sure by motor abilities (Mirvić, 2006; Hadžić, 2007; Bajrić, et al., 2011).

Since body height and weght are not represents of whole morphological space, lack of body height and weght influence on some motoric achievements tests performing in basketball does not allow us to conclude that there is no morphological characteristics contribution on those tests performing. Some researches have determined that there are other anthropometric characteristics who contribute to motoric achievements test performing in basketball (Nikolić, 2006; Aruković, 2012; 2013).

Conclusion

Based on the obtained results we can notice that in some tests and subsamples body weight and height contribution on motoric achievemets tests performing has been determined. At the youngest age body height influence on catching and passing in a set position test performing has been determined, while at elder junior high school students body weight influence has been determined. In those tests in which successful performing has been influenced by body movement in space, predicate set influence on test performing has not been determined. Lack of influence of predicate set doesn`t exclude other anthropometric measures and anthropological characteristics influence. Shooting on basket in 30 second have been influenced by body height and weight at 9th graders and only body height at high school students, in other words taller persons have better chances to achieve bet-

ter results. Lack of body height influence on shooting on basket in 30 second test at youngest age shows that for successeful performing on standard basket height certain body height of samples has been required. Those results show that at younger junior highschool age using of shorter baskets would be very effective in order to make basketball classes more interesting. These results are specific because of the fact that in some age variables in predicate set influence successful performing,while in other age the lack of this influence has been noticed. Therefore, we can conclude that during ontogenesis there is relation reduction between some characteristics in order to better connections of others, what was the case in this research (Meinel, et al., 2004).

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