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Original Article

Relation of morphological variables and coordination of the 7th grade boys

MILOVAN LJUBOJEVIĆ[1], DANILO BOJANIĆ[2]
[1,2] The University of Montenegro, Faculty of Sports and Physical Education, Niksic, MONTENEGRO

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Abstract:
Coordination level is very important for executing moving assignments. The higher level of coordination, the more beautiful, faster, and more precise one can achieve, the goal of movement, and fatigue tempo is slower. It is well known that children in prepubescent period, when their growth and development is on its peak, lose the quality of coordination. The aim of this paper is to determine the relations between morphological characteristics and coordination among the boys. We were interested in exemining relations between morphological characteristics and coordination pointers. On the sample of 73 boys of the 7th grade elementary school, it was determined that only weight and forearm circumference were important predictor of results at pull through and jumpover test. The results of this study show that the morphological characteristics are of importance for the results of the coordination tests. Further statistical analysis of results shows that there are many relationships and correlations among the studied areas (morphological and motoric), and between themselves.
Key words: coordination, morphological characteristics, male students, 7th grade

Introduction

Evolution of the skills linked to motor activity is mainly structured around motor coordination (Benjumea, J. M. C. et al, 2015). Managing of the body in space and time is called coordination. Coordination is the ability which comprises the following components: rhythm, balance, reaction ability, the ability of kinesthetic differentiation, orientation in space, the adequacy of movement and synchronization of movements in time (Metikoš & Hošek, 1972; Viskić - Stalec 1973; Hošek, 1976) The phsycological base of coordination is in synchronisating the neuro-muscular system, and transfer of motor impulses from one center to other motoric centers that manage other parts of the body. Well-developed sense for movement is important for good coordination. This sensation, with the presence of visual and audio information, allows receiving information about the position of different parts of the body, tension and actions of various muscles, as well as body position in space and dynamics of movements. Good coordination is characterized by involvement of muscles that are most appropriate for certain tasks in the most efficient order, thereby inhibiting the antagonists and by regulating the frequency of nerve impulses, and full synchronization of higher regulatory centers and the peripheral parts of the locomotor apparatus (Metikoš et al., 2003). What is very important that the person who has a better coordination for performing the same movement uses less energy than a person with poor coordination (Bompa, 2005).

Coordination can be divided on following categories: general and specific. The general coordination is the basis for the development of specific coordination. Comprehensive development and diversity in the further stages of sport's specification will depend on the specialization of the general coordination and multi-faceted exposure to directional drills and skills during childhood and adolescence (Drabik, 1996; Bompa, 2005). Specific coordination allows fast, accurate and easy performing of complex technical and tactical structures in different conditions. It can be developed by performing specific actions in some sports, from unusual starting positions, as well as in more demanding conditions. Specific coordination is especially important for those sports with plenty of technical elements (sports games).

Apart from the way of training and level of motor skills, coordination is closely linked to morphological characteristics, especially with rapid growth and development during puberty (Drabik, 1996; Nićin, 2000; Nikolic, 2006; Krsmanovic & Radosav, 2008). Because of disturbed coordination (due to rapid growth), especially agility and speed, such a clumsy, stiff, awkward movements are exposed to ridicule, what can have very negative consequences for adolescents (Nićin, 2000).

The aim of this research was to determine connection between morphological features and coordination with students, as well as a possible prediction of scores achieved in coordination parameters based on knowledge about students' morphological features.

Corresponding autor: Milovan Ljubojević, E-mail: milovan.lj@ac.me

Material & Method

A. Independent variables:

Variables for measurement of morphological status:

- for longitudinal skeleton dimensionality body height was measured;
- for volume and body mass the following variables were measured: forearm circumference, lower-leg circumference and body mass
- For subcutaneous fat tissue assessment the following variables were measured: upper arm skinfold, stomach skinfold and back skinfold

B. Dependent variables:

Motor variables for coordination assessment:

• Ball wall bouncing for 15 s - At a distance 150 cm from the wall student hits the ball for volleyball against the wall, catch the ball and repeats procedure during 15 s. Only number of successful catching the ball is counted.

• Basketball dribbling with the left hand - on the track length of 10 m 5 cones stands at a distance of 2 m. infront of the first crate is withdrawn line of 1 m length which is 2 m away from cone. Student needs to keep and make dribbling with basketball's ball as fast as she can in slalom between the cones. At the last cone student makes a turn for 180 □ and in the same way (in slalom) is returned to the starting line. The student always takes the ball by better hand. Three attempts are allowed and the best-effort time in tenths of seconds is counted. In case that during the conduct of the task student crashed cone task is not interrupted, if her ball "escape" she is going for it and continue the task from where she made a mistake.

• Pull through and jumpovers - the track length is 10 m and at every 2 m is placed a framework of Swedish crate, put on the ground with its narrow side. Start line is 2 m before the first crate and before the last crate at a distance of 2m is ball. Student runs from the starting line to the first crate and jump over it, pull through the second crate, jump over the third one, pull through the fourth, then run to the ball and turn around and run to the start line by repeating procedure with crates in return.

The sample consisted of 73 boys, students of the 7th grade of elementary school in Danilovgrad. The measurement was performed during regular PE classes.

The data were processed in SPSS program and the techniques were descriptive statistics, Pearson's correlation coefficient and multiple regression analysis.

The research was carried out during regular PE classes. The measurement was done by trained measurement practitioners – PE teachers, according to the methods recommended by the International biological program (IBP). In order to perform measurement of the selected anthropometric dimensions in the measuring procedure the following tools were used: medical decimal scale with the result precision of 0,1 kg; Martin-type anthropometer with result precision of 0,1 cm; the measuring tape of plastic materials, 1m long which enables result precision of 0,1 cm; caliper for skinfold measurement, stopwatch, volleyballs' and basketballs' balls, cones, Swedish crate.

Results

Firstly, the descriptive statistics result of the variables monitored in the research shall be displayed.

The data were analyzed by multiple regression analysis in order to determine whether it is possible, based on the knowledge of the results of the independent variables, to evaluate the subjects' results on the test of ball wall bouncing for 15 s. In data processing it was used the stepwise method. The coefficient of multiple determination was obtained by this method with the all predictors included was $R^2 = 0,106$ (Adjusted $R^2 = 0,010$), $F = 1,107$, $df = 7$, $p < ,370$.

Table 1: Descriptive statistics

VARIABLES	M	SD
Height (cm)	161,23	5,68
Weight (kg)	51,78	9,91
Forearm circumference (cm)	21,20	2,33
Lower-leg circumference (cm)	31,16	4,51
Upper arm skinfold (cm)	0,70	0,55
Stomach skinfold (cm)	0,97	0,82
Back skinfold (cm)	0,62	0,55
Ball wall bouncing for 15 s (s)	18,27	2,82
Basketball dribbling with the left hand (s)	11,01	2,32
Pull through and jumpovers (s)	18,76	3,61

Ball wall bouncing for 15 s was the dependent variable while the remaining variables (back skinfold, height, stomach skinfold, lower-leg circumference, weight, upper arm skinfold, forearm circumference) were independent, with an aim to se whether, based on knowledge of the results in some of these variables, it was

possible to predict the result that the boys shall achieve in ball wall bouncing for 15 s. These variables didn't proved to be statistically significant results predictor of the test results of ball wall bouncing for 15 s.

The coefficient of multiple determination, obtained by this method with calculated all predictors was R^2 = 0,093 (Adjusted R^2 = - 0,005), F = 0,947, df = 7, p ‹ ,477. Basketball dribbling with the left hand was the dependent variable while the remaining variables were independent, with an aim to establish whether, based on knowledge of the results in some of these variables, it was possible to predict the result that the boys will achieve in basketball dribbling with the left hand test. The predictor variables didn't proved to be statistically significant.

The coefficient of multiple determination obtained by this method with calculated all predictors was R^2 = 0,305 (Adjusted R^2 = 0,285), F = 5,100 , df = 1, p ‹ ,027. Pull through and jumpovers was the dependent variable while the remaining variables were independent, with an aim to establish whether, based on knowledge of the results in some of these variables, it was possible to predict the result that the boys will achieve in pull through and jumpovers test. The variables that proved to be statistically significant results predictors of the test results were forearm circumference and weight. The higher pull through and jumpovers test result, the subject is heavier and his forearm circumference is bigger.

Table 2: The results of regression analysis of the set of morphological variables and the test of pull through and jumpovers

Variables	B	Std. Error	t	sig	Corr. partial
Intercept	2,144	3,291	,652	,517	
Forearm circumference	,540	,188	2,874	,005	,505
Weight	9,978E-02	,044	2,258	,027	,473

There are a lot of correlation between these two areas (morphological and motoric), but also within themselves. The forearm circumference and lower leg circumference are significantly correlated (r = 0.570, p <.000), which can be explained by the fact still have not formed sufficiently muscles in the extremities, and the volume is largely determined by the dimensions of the bones.

Table 3: Correlations of the set of morphological and motor variables

Variables	1	2	3	4	5	6	7	8	9
1. Height									
2. Weight	, 384***								
3. Forearm circumference	, 293**	, 570***							
4. Lower-leg circumference	, 090	, 284*	, 649***						
5. Upper arm skinfold	, 055	, 297**	, 477***	, 351**					
6. Stomach skinfold	, 053	, 471***	, 633***	, 449***	, 877***				
7. Back skinfold	, 111	, 297**	, 393***	, 288**	, 906***	, 787***			
8. Ball wall bouncing for 15 s	, 056	- , 109	,145	, 079	- , 050	, 005	-,056		
9. Basketball dribbling with the left hand	, 042	, 119	, 013	,027	,026	, 067	-,072	-,355**	
10. Pull through and jumpovers	, 242*	, 473***	, 505***	, 312**	, 362**	, 463***	, 368***	-,188	,076

NOTES: * - CORRELATION IS SIGNICICANT AT THE 0.05 LEVEL (TWO-TAILED),
** - CORRELATION IS SIGNICICANT AT THE 0.01 LEVEL (TWO-TAILED),
*** - CORRELATION IS SIGNICICANT AT THE 0.001 LEVEL (TWO-TAILED)

There is a statistically significant correlation between height and weight (r = 0.384, p <.000) of low intensity and positive direction, which shows that this age when most boys are growing and gaining weight, and higher boys also tend to be weights than lower boys. With the physical growth of bone and muscles, in boys in this period, also increases the percentage of body fat. Proved to be statistically significant, although with moderate to intermediate intensity, the correlation between forearm circumference and upper arm skinfold - (r = 0.477, p <.000), forearm circumference and stomach skinfold (r = 0.633, p <.000) and forearm circumference and back skinfold (r = 0.393, p <.000).

Between ball wall bouncing for 15 s and other variables there was no statistically significant correlation. There is a statistically significant correlation intermediate intensity and the positive direction between forearm circumference and score on pull through and jumpovers test ($r = 0.505$, $p < .000$). The crucial factor in this correlation is the sudden growth, during which boys stagnate or lose coordination, so boys who have not yet entered in this period have better coordination, which reflects on scores of test of pull through and jumpovers.

There was statistically significant correlation between lower-leg circumference and upper arm skinfold ($r = 0.477$, $p < .000$), as well as between lower-leg circumference and back skinfold ($r = 0.288$, $p < .000$). Both correlations are of positive direction. These correlations are logical due to rapid growth in this period in boys which inevitably leads to an increase in limb volume due to growth of bone and muscle mass, and an increase in adipose tissue as demonstrated by measuring the wrinkles in certain places.

There is a statistically significant correlation extremely high intensity and positive direction ($r = 0.906$, $p < .000$) between upper arm skinfold and back skinfold . It have already mentioned that boys at this age have increase percentage of body fat and this was confirmed on places marked for measuring skinfold.

There is a statistically significant correlation between ball wall bouncing for 15 s and basketball dribbling with the left hand ($r = - 0.355$, $p < .000$). The correlation is low intensity and negative direction and shows that boys who have had better results on the test ball wall bouncing for 15 s attained a poorer performance on test basketball dribbling with the left hand. This can be explained by the fact that this coordination has specific and not global character.

Discusion

Coordination, as well as motor skills, is the necessary condition for successful engagement in any sport. A person with a better coordination, the faster, better, easier, and with less energy performing a given movement, the faster they will adopt new sports skills, be prepared to react in unknown circumstances on the ground. Therefore, one should constantly work to improve coordination. Perhaps the greatest potential for the development of coordination exists in physical education, due to variety of exercises and movements that boys need to master on physical education classes, in the sensitive stages of development, may contribute to the development of coordination (Ljach & Witkowski, 2009). Also, physical education classes, with continuous monitoring of growth and development of students, give a good insight into whether the motoric and coordination abilities of students are progressing, and whether there is a progress or stagnation as the result of disharmony in the development of morphological characteristics.

Correlations between forearm circumference and upper arm skinfold, forearm circumference and stomach skinfold, forearm circumference and back skinfold proved to be statistically significant. Similar results and correlations are also found in some earlier and more comprehensive studies (Nikolic, 2006; Radosav & Krsmanovic, 2008, Coelho et al., 2010).

The results also show that students who have a smaller forearm circumference, for the same time have more depreciation of the ball, i.e. repeatedly threw and caught the ball which rebounded against the wall. This confirms that students with smaller forearm circumference have better hand coordination. However, since the coordination is very specific characteristic and depends on many factors, this can not be said with certainty. Because it has been proven that if someone is good at a sport, does not mean it will be good in another. Also, the question of the level of coordination of the individual depends on how many new elements in activities that an individual exercise.

Students who have lower values of back skinfold and larger forearm circumference needs more time to conduct a ball between the cones. In this test, students who have a larger forearm circumference have poorer results, suggesting that they have lower coordination of hand. This conclusion is supported by the fact that the test that examines the arm coordination (ball wall bouncing for 15 s) gives the same results.

Pull through and jumpovers test, which belongs to a group of tests that evaluated the ability to reorganize stereotype of movement, ie, how to the entire body to be able to quickly, accurately and timely change positions in relation to the tasks. However, here morphological characteristics, especially the forearm circumference significantly affect the results achieved. Students who had a larger forearm circumference need more time to implement the task pull through and jumpovers. It is easy to conclude that the results are similar to those of the previous two tests, which leads to the same conclusion: that the boys that had a greater forearm circumference show poorer coordination at all conducted tests. D'Hondt et. al. (2013) found a strong link between motor coordination and obesity and the weight of children aged from 6-10 over time.

The results of this study showed that the morphological characteristics are of importance for the results of the coordination tests: on the test of ball wall bouncing for 15s, better results have boys with lower forearm circumference, on the test basketball dribbling with the left hand, better results have students with higher upper arm skinfold and a smaller forearm circumference, on the pull through and jumpovers, better result have boys with the smaller forearm circumference. Further statistical analysis of results showed that there were many relationships and correlations among the studied areas (morphological and motoric), and between themselves.

Conclusions

All abovementioned suggests that the morphological characteristics are significantly correlated with scores on tests of coordination, especially at this age, when the boys are in the phase of rapid growth and when their abilities oscillate.

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