

**SIGNIFICANCE OF THE DIFFERENCES IN MOTOR ABILITIES  
AND MORPHOLOGICAL CHARACTERISTICS  
BETWEEN BOYS AND GIRLS AGED 9 TO 11 FOR PHYSICAL  
EDUCATION OPTIMIZATION**

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**Abstract.** *The study sample consisted of 70 participants, 36 male and 34 female pupils aged 9-11, attending the P.S. "Ivo Lola Ribar" from Sombor. The aim of the study was to evaluate the motor learning abilities of the pupils, help them adapt and make the process more interesting for them, and gain insight into the initial state of the psychomotor domain of pupils at the beginning of the school year or take the necessary steps for adequate optimization of physical education. A multivariate analysis of variance showed the statistically significant difference ( $P = 0.00$ ) in the motor area between the boys and girls. An individual analysis found differences in the following variables/motor tests: the 30-min run with a standing start ( $p = 0.00$ ), Folding endurance ( $p = 0.00$ ) and Throwing a medicine ball (2 kg) from a prone position ( $p = 0.00$ ), a six-minute run ( $p = 0.00$ ) in favor of the boys and variables Bouncing a ball from the wall ( $p = 0.00$ ), hyperextensions a bench ( $p = 0.02$ ) in favor of girls. There was a statistically significant higher level of manifestation of power and speed in boys caused by the consequences of the level of physical activity of the boys, a higher level of manifestation flexibility and coordination among the girls, which is caused by the biological structure of the body and the better perception of the girls. Statistically significant differences in the body weight and body height of the analyzed sample of boys and girls were not obtained.*

**Key words:** *younger school age, gender, motor abilities*

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## INTRODUCTION

The human need for physical activity, or manifestation of motion and movement, is one of the conditions for the survival of humans as a species and as individuals (Keric & Ujsasi, 2014). Contemporary approaches to motor (physical) abilities deal with physical condition (physical fitness) as well as a number of characteristics that a person has or is developing, referring to the ability to perform a variety of physical activities. Physical fitness includes components important for good health (health-related fitness), performance in different sports activities (skill-related fitness) and physiological components (physiological fitness). This model is relatively recent. It, however, directly affects the everyday teaching practices and procedures of evaluation in physical education in school. Therefore, the battery of motor tests, which are now used in schools, is dominated by tests for the assessment of the components that are important for health. These include: cardio-respiratory endurance (aerobic capacity), flexibility, muscular endurance, muscular strength and body composition. People who have high levels of cardio-respiratory endurance, muscular strength and endurance, flexibility and proper body composition, have a lower risk of developing chronic diseases and have higher quality of life (Corbin, Pangraz, & Frank, 2000). On the other hand, there are important skills for success in sports, such as precision, coordination, balance, speed, agility, reaction time and explosive strength. These components of physical fitness allow individuals to quickly adopt motor habits and reach a high score in sports. Since they are only indirectly related to the improvement of health, by increasing the individual's ability to participate in sports they are less represented in the battery of tests that are now widely used in schools. The results obtained by testing are important indicators of the pupils' progress, efficiency programs and applied methods. They can also provide important information for pupils and parents about the level of motor skills and be a strong motivational tool for further activity in the classroom and beyond.

Certain characteristics of the most successful children can develop the so-called "Sensible stages". Then, the principles of nature help one achieve the most significant pace of development of the individual, increase adaptive capabilities in relation to exogenous factors and create special favorable conditions for the formation of certain motor skills. After the age of ten, movements gain a new quality that is reflected in the improvement of strength, speed, accuracy, and coordination. Definition of motor skills is conditioned primarily by the rate of maturation of the central nervous system (CNS) due to which a child becomes able to control his movements and to harmonize them. This is reflected in the movements which are manifested in the speed of capture, landing, throws and other manipulative skills.

The differences in motor behavior are attributed to: coordination, explosive strength, speed of alternative movements, balance and flexibility, exogenous factors, as well as the functioning of the CNS during the manifestation of certain skills. Differences between boys and girls are attributed to environmental influences (depending on how much the child is active) and physical maturation of individuals (Lazarević, Orlić, Lazarević, & Janić, 2015).

Body height and weight are important indicators of physical growth, development of guidelines and maturity of the body. In some ontogenetic stages of growth and development, the influence and interaction of genetic factors and environmental factors on the growth and development of children are not the same (Božić-Krstić, Rakić & Pavlica, 2003). Regular monitoring of physical growth and development contributes to the detection of disorders of growth and development, early identification of obesity and malnutrition. It enables an individual approach to pupils and better programming of physical education.

Faye, Seck, & Cisse (1999); Katić, Pejčić, & Babin (2004); Klinčarov & Stojanović (2006); Marta, Marinho, Barbosa, Izquierdo, & Marques (2013); Catley and Tomkinson (2013); Bigovic (2006); Krsmanović & Radosav (2008) all studied the motor abilities of pupils of a younger school age. Statistically significant differences in relation to the sex and age of the participants, anthropometric characteristics and motor abilities were determined. In the space of morphological characteristics (longitudinal dimensionality), the girls dominated, while in the area of motor abilities (especially power) the boys dominated. In the tests of balance, and flexibility of coordination a slight advantage of preadolescent girls over boys was established.

The fact is that today younger school age children do not satisfy all the needs for movement “created” by phylogenesis. Therefore, the question is how the trend of decline of their individual characteristics observed in some studies (primarily in terms of motor skills), affects their health and the level of functional ability. It was found that the level of functional capacity varies by gender (Katić et al., 2004; Marta, 2013), and that they are under the direct influence of the physical activity of the child (Harrell et al., 1996; Pejčić, Trajkovski-Višić, & Malacko, 2009; D’Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2009; Karaleić, Andjelković, Arsenijević, Lolić, & Lolić, 2011).

The subject matter of this paper is related to the need to establish the level of motor skills and morphological characteristics of younger school aged children at the beginning of the school year. Based on the evaluation of motor skills, the optimization of teaching is necessary. Then, on the basis of the initial state of the level of motor abilities of the pupils, further teaching should be adapted to the individual abilities of the pupils. This paper deals with motor skills: coordination, explosive strength of the legs and arms, static strength of the shoulders, flexibility of the thigh, running speed, endurance (functional capacity) and repetitive muscle strength of the hull, as well as morphological characteristics: body height and body weight. The study was managed with the assumption that there is a statistically significant difference in the level of motor abilities and morphological characteristics of younger school aged boys and girls in favor of the boys.

## METHODS

The tests and measurements were done at the beginning of the 2015/2016 school year, as part of the regular physical education classes. The total sample consisted of 70 pupils attending the "Ivo Lola Ribar" primary school in Sombor, aged 9 to 11 years, of which 36 were boys and 34 girls.

The anthropometric characteristics were measured: body height (the longitudinality of the skeleton), and body weight. The assessment included the following tests: the 30-minute run with a standing start (linear velocity); bouncing a ball against a wall (coordination); the Standing long jump (explosive leg strength); hyperextensions on a bench (flexibility); folding endurance (estimated static muscle force of the arms and shoulders); Throwing a medicine ball (2 kg) from a prone position (Explosive power of the arms and shoulders); the six-minute run (endurance) and the torso lift 30 s (repetitive muscle strength of the abdomen).

For the purpose of carrying out the research, first the permission from the director of the "Ivo Lola Ribar" primary school in Sombor was requested. After obtaining permission, the sample of boys and girls (70), or their parents, were given questionnaires, in accordance with ethical principles (following the Helsinki Declaration), and the parents approved the

participation of their children in the research project by giving their signature. The survey was conducted on a sample of third grade pupils, aged 9 to 10. A complete battery of tests was carried out during the physical education classes by the author of the work in collaboration with physical education teachers and homeroom teachers who are employed in the school.

The following statistical analyses of the data were performed: arithmetic mean (AM), standard deviation (S), minimum (MIN) and maximum (MAX) value of the measurement results, the variation coefficient (CV). A statistically significant difference for the morphological variables of the t-test for independent samples was determined. A statistically significant difference between the boys and girls, for the motor variables was determined using a multivariate analysis of variance (MANOVA).

## RESULTS

Based on descriptive statistics, we can see various outcomes from variables for the evaluation of coordination, functional abilities of the girls, flexibility, static muscle strength of the hand, explosive muscle strength of the arms and shoulders and repetitive muscle strength of the abdomen in both analyzed subsamples (Table 1) which may be caused by different influences of genetic factors and environmental factors and the fact that children come from different social microenvironments. Among the analyzed motor variables, there was a similar level of running speed, the 30-meter run with a standing start variable, explosive leg strength, the standing long jump, assessment of the functional capacity of the body, the six-minute run only for the subsample of boys.

**Table 1** Descriptive statistics of the motor variables and differences between groups

Variable	Boys			Girls			f	p
	AM	S	CV	AM	S	CV		
30-minute run with a standing start (0.1 s)	52,60	4,14	7,87	56,23	4,36	7,75	<b>11,97</b>	<b>0,00</b>
Bouncing a ball against a wall (Freq.)	6,54	2,84	7,75	10,43	4,13	39,57	<b>21,01</b>	<b>0,00</b>
Standing long jump (cm)	148,00	22,48	15,19	144,97	12,96	8,94	0,47	0,49
Hyperextensions on a bench (cm)	10,00	5,25	52,50	12,89	5,23	40,57	<b>5,31</b>	<b>0,02</b>
Folding endurance (0,1 s)	304,89	212,13	69,58	131,24	118,73	90,47	<b>17,85</b>	<b>0,00</b>
Throwing a medicine ball (2 kg) from a prone position (cm)	284,71	59,78	20,99	227,43	71,43	31,41	<b>13,11</b>	<b>0,00</b>
The six-minute run (m)	848,00	126,46	14,91	694,57	157,52	22,68	<b>20,19</b>	<b>0,00</b>
Torso lifts for 30 s	22,11	9,27	41,93	24,49	10,02	40,91	1,06	0,31

F=13,01 P=0,00

Legend: AM–arithmetic mean; S - standard deviation; CV - coefficient of variation; F - f univariate test; p - level of statistical significance of the f test; F – Wilkson s multivariate F test; p - statistical significance multivariate F test

Based on the F values (Table 1) it can be concluded that there is a statistically significant difference between the boys and girls from Sombor (P = 0.00) in the level of their motor

skills, including the whole system of applied variables. The individual analysis of each motor variable shows that there are significant differences in the tests: the 30-meter run with a standing start ( $p = 0.00$ ), folding endurance ( $p = 0.00$ ) and throwing a medicine ball from a prone position ( $p = 0.00$ ), the six-minute run ( $p = 0.00$ ) in favor of the boys. The girls had statistically better results in the following tests: bouncing a ball against a wall ( $p = 0.00$ ) and hyperextensions on a bench ( $p = 0.02$ ).

It can be noticed from Table 2 that the results of both analyzed subsamples are homogenous, and the variables for assessing the longitudinality of the skeleton (body height). For the other analyzed variables (for assessing body weight), the heterogeneity of the results can be marked. Statistically significant differences in the basic morphological variables were observed ( $p > 0.05$ ) (Table 2) due to the harmonious growth and development of the bodies of boys and girls, or a calm period of growth and development.

**Table 2** Descriptive statistics and differences between groups for the morphological variables

Variable	Boys			Girls			Variation AM	t	p
	AM	S	CV	AM	S	CV			
Body height (mm)	1463,17	67,29	4,59	1461,80	81,54	5,58	1,37	0,08	0,94
Weight (kg)	388,43	78,78	20,28	364,11	66,98	18,4	24,32	1,39	0,17

Legend: t-test; p - level of statistical significance for the t-test

## DISCUSSION

The change in the results of the motor activities of younger school age children, regardless of their gender, always happens in accordance with certain changes in the muscle, musculoskeletal and other systems. Those changes in motor skills occur in the current socio-economic conditions, which are typical for the environment of an individual or group of people who represent a set of cultural, material, urban and other factors. Therefore, the change in the results is not only of a biological and physiological nature, but may be of the result of different socio-cultural conditions, findings and circumstances that are typical for a given environment. The influence of social factors on participation in physical activity, can be very strong expressed in younger aged school children. This is supported by the research of socio-economic factors, the status of children and their impact on participation in physical activity (Heersink, & Volpe, 2004; Neves et al. 2005; Matsudo et al., 2006). The research Mikalački, Hosek-Momirović & Bala (2006), have shown that the socio-economic status of early school age children affects the level of their motor skills (primarily Coordination), which are associated with better opportunities for taking part in sports activities.

Regular physical activity carries with it a certain health gain, affects body composition, develops the muscle and skeletal system (Malina & Bouchard, 1991). Physical education lessons, which are a mandatory part of the curriculum, are second in number of classes to mathematics and the Serbian language, but do not give the desired results. Content that is realized in physical education classes lacks the necessary intensity that can cause the irritation to improve the physical development and physical abilities of school age children (Madić & Dragić, 1989; Pate et al., 2006). Classes are not homogeneous. Pupils differ in their mental and physical abilities based on their interests, attitudes, motivations. Their options are very different, and they affect the speed of acquisition of knowledge, skills and habits. This creates difficulties for the physical education teachers whose work is also a

challenge. Physical education is mainly adapted to the average pupils, thus negating the basic biological laws and does not take into account the differences in psychomotor skills. Such an approach to teaching bears a series of unintended consequences in the recruitment and promotion of pupils, because the teaching content is too easy for some pupils, while for others it is too heavy. Optimizing teaching, the teaching process, based on the principles of growth and development of teaching requirements are aligned with individual pupils' abilities and their characteristics in operation. Monitoring the growth and development of pupils should be continuous because it indicates the direction in which the teacher should focus his work. Contents, methods and loads should stimulate dynamic development, guided by the knowledge of the transformation process for the development of anthropological dimensions (Bala, 1981; Pržulj, 2012). Optimization of physical education instruction in certain phases of motor training is necessary, bearing in mind that the body of younger school children is a specific physiological and anatomical-functional system that is in a constant differential and progressive development.

The exploitation of biological resources is very different according to the different impact of social environment in the most intensive phase of growth and development. Factors of social protection, such as social standards, cultural levels, the place and role of physical education in it, can affect the development of the motor and cognitive skills, as well as the morphological characteristics of children.

The habits of boys and girls of the same age are different. Boys play more outdoors, (practice a variety of ball games: e.g. football, catch etc.), climbing trees, mimicking their "cartoon heroes". These activities are dominated by the manifestation of endurance (long-term physical activity), static and explosive power and hand speed (running). Heterogeneous habits of children of different sexes, may affect the existence of differences in the manifestation of motor abilities (Carlos et al., 2014). These results may have been able to influence exogenous (environment and physical activity of children) and endogenous factors (greater desire of the boys to achieve success in motor tasks and competitions dominated by strength and speed).

Unlike boys, girls of the same age have different interests. Climbing for them is less interesting, girls are too passive in games, and the desire to compete subsides. Girls 9 years old and younger are preoccupied with playing with dolls, while older girls, aged 10 to 11, today already have their own "profile" on various social networks. As a result, most of their time they spend at the computer for communicating by email or with their mobile phones where "everything" is available to them. The above listed girls' activities do not contribute significantly to the development of their psychosomatic status. The research results can be correlated with the facts that the physical activity of girls after 6 years declines (Bailey, Wellard, & Dismore, 2004), referring to research Kemper (1994). A possible explanation, other than the effect of age as well as of biological factors, lies in the fact that the mentioned decline in physical activity among girls aged 11 to 12 coincides with the period of harsh interaction with the ideology of gender socialization influences. From the biological factors, what is interesting is the impact of body composition, which in the age of puberty inevitably changes, but in a different way in girls and in boys. The increase in the level of estrogen in early adolescence in girls, contributes to the increase in body fat, while the influence of male sex hormones in boys during the same period leads to an increase in muscle mass. The resulting changes in body composition "favor" the boys when it comes to dealing with sport and physical activity in general. On the other hand, as far as organized sports are concerned, men are more active. In a population of young people, ages 15 to 24, the percentage of women who regularly engage in physical activity

or sport is 37%, and of men 63% (Rowland, 1999). Similar views were pointed out by Djordjić and Krneta (2007) who found that between boys and girls of this age there are significant differences in the perception of the sport and their own competence in sport. The problem of gender stereotyping when it comes to sport is much more prevalent in girls. The girls find sport to be primarily for boys, attributing to them its distinctly masculine qualities.

In the variables for evaluation of flexibility, statistically obtained significant differences in favor of girls are expected, if we have in mind the anatomical differences (eg. construction of pelvic, acetabular head is under small angle to the femur enabling higher stretching of muscles on backside of the leg). These results confirmed the research of Gajić & Kalajdžić (1986), in which the girls were dominant in flexibility, and the boys in the events of power. Also, girls achieved significantly better results in the test for the evaluation of coordination (Bouncing a ball against a wall) than boys of the same age. This fact can be explained by the part of the cortex among the girls that matures earlier, which is responsible for coordination. Subcortical parts of the brain are developed, the flow pulse is faster, a sensory apparatus regulating hand-eye coordination is more developed in girls, which is why the results obtained in this study can be considered logical. This study confirmed the results obtained by Krsmanović & Radosav (2008) that boys are more dominant in tests of strength and speed running, and girls in tests of flexibility.

As for the physical development of early school age children (between 9 and 11), the main characteristics of the general good physical condition is a favorable ratio of weight to height of the body (Nićin & Stjepić, 2008). Probably because of this fact there are no statistically significant differences between boys and girls in the monitored anthropometric measures.

The practical value of the work lies in the fact that the assessment of motor abilities produced the basis for monitoring the growth and development of children attending primary school in Sombor. Teachers, on the basis of a very important (even inevitable) information about the initial state of the relevant characteristics can plan physical education, according to the real possibilities of children. Availability of research results to pupils and parents can be a powerful motivational tool for further physical activity of children in the classroom and beyond. Given that, during the growth and development of relations between motor abilities and morphological characteristics, it would be necessary to monitor them in different age groups. After finishing the first few years of elementary school (from 7 to 11 years), in which the development of motor skills is still general in nature, children experience "an explosion" and differentiation of motor abilities.

## CONCLUSION

For the optimization of the physical education stages of differentiation of motor skills and motor development stages, based on exact (measuring received) information, the only solution is to properly load and motivate pupils. Results of the evaluation of health forms can be used to help both teachers and pupils in planning learning/teaching activities in further work (Sariscsany et al., 2011). By testing the physical form, feedback that is essential in planning and programming of physical education is provided.

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## **ZNAČAJ RAZLIKA U MOTORIČKIM SPOSOBNOSTIMA I MORFOLOŠKIM KARAKTERISTIKAMA IZMEĐU DEČAKA I DEVOJČICA UZRASTA 9-11 GODINA ZA OPTIMIZACIJU NASTAVE FIZIČKOG VASPITANJA**

*Uzorak istraživanja činilo je 70 ispitanika, 36 učenika i 34 učenica uzrasta 9-11 godina O.Š. „Ivo Lola Ribar” iz Sombora. Cilj rada je bio da se evaluacijom motoričkih sposobnosti nastava prilagodi sposobnostima učenika, da im se olakša i učini zanimljivijom, i dobije uvid u inicijalno stanje psihomotornog domena učenika na početku školske godine odnosno izvrši adekvatnija optimizacija nastave fizičkog vaspitanja. Primenom multivarijantne analize varijanse utvrđeno je postojanje statistički značajne razlike ( $P=0,00$ ) u motoričkom prostoru dečaka i devojčica. Pojedinačnom analizom razlike su konstatovane u varijablama motoričkih testova: Trčanje 30 m iz visokog starta ( $p=0,00$ ), Izdržaj u zgibu ( $p=0,00$ ) i Bacanje medicinke (2 kg) iz ležećeg položaja na leđima ( $p=0,00$ ), Trčanje 6 minuta ( $p=0,00$ ) u korist dečaka i varijabli Odbijanje lopte od zida ( $p=0,00$ ), Pretklon na klupici ( $p=0,02$ ) u korist devojčica. Uočen je statistički značajno viši nivo ispoljavanja snage i brzine kod dečaka prouzrokovan posledicama nivoa fizičke aktivnosti dečaka, a viši manifestni nivo ispoljavanja gipkosti i koordinacije kod devojčica, što je prouzrokovano biološkom građom tela i boljom percepcijom devojčica. Nisu dobijene statistički značajne razlike u telesnoj masi i visini tela analiziranog uzorka dečaka i devojčica.*

Ključne reči: *mlađi školski uzrast, pol, motoričke sposobnosti*