

## DIFFERENCES OF SEGMENTS OF MORPHOLOGICAL AND MOTOR SPACE OF MIDDLE SCHOLERS

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### Abstract

*Diagnostics of students in Physical education is important because of the development of plan and program of the work and monitoring and insight in their current condition. It is clear that individual differences during the growth and development contribute to the variability of functions and abilities of a man and therefore it is important to monitor and assess characteristics and abilities of certain subjects. Morphological characteristics are inevitable segment within the diagnostics of motor skills and very often they are the subject of scientific research. The space of morphological characteristics and motor skills of boys and girls of middle schoolers was analyzed in the paper, with the aim of confirming the differences regarding the sex. 9 variables which defined morphological space (2 variables) and motor space (7 variables) were measured. In data analysis by the application of T-test we got the results which scientifically explain the differences among students ( $p < 0.05$ ;  $p < 0.01$ ). Only in two variables those differences were statistically significant in favor of boys (AMAS = -0,010\*) and (MTR30 = 0,004\*\*).*

**Key words:** *growing up stages, anthropometric characteristics, motor skills, differentiation*

### Introduction

Planning of teaching is a very complex process where the teacher uses his knowledge, experience as well as professional literature in order to obtain effectiveness of educational work. Methods and means that will be applied in realization of the set goal and operational tasks are also planned, as well as the method of control and verification of the results (Krsmanović, Arunović, & Madić, 1998). Unified program tasks, which in most cases are not in accordance with real necessities and possibilities of students, are very often the starting point in teaching practice. However, to make and realize adequate teaching programs, it is essential to have thorough knowledge of psychosomatic status of students, their sensitive developmental periods and based on them plan the teaching program of Physical education. Only based on complete information of condition and possibilities of students can we objectively confirm the tasks and set standards that should be reached by increasing the level of students' skills (Dragaš, 1998).

This is very important because each individual goes through certain periods of growth and development characterised by certain psychosomatic changes. Physical education represents the basic, organisational, exogenous factor that affects the developmental changes of children. Therefore, it is necessary to measure, monitor and develop anthropometric characteristics and motor skills (Gojković, & Radulović, 2010). Growth and development of the organism is a relative process and it depends on various age periods and it is followed by certain anatomical and functional changes (Jakonić & Bajić, 1996). Certain factors influence on the process of growth and development.

Beside physical education, as an exogenous factor, the sex also has a significant influence on growth and development. Most properties differ in the childhood of both male and female, while the changes are more expressed of grown-ups (Đurašković, 2002). Concerning exogenous factors, geografic and climate factors have a great role, too. Furthermore, the influence of social and economic factors, proved by researches all over the world, show that body growth and development in economically stronger families is better than of children who comes from poorer families (for example, height, weight). The difference is caused by better quality of food, housing conditions, social and hygiene factors. Biological growth and development of children is carried out according to certain laws. The period of middle schoolers includes the age between 11 and 15 years and it is considered as the period of intensive growth and development of both sexes, and it can be divided to pre-puberty and post-puberty time (Pavlović, 2006). The differences between the sexes in this period are more expressed in comparison to the previous ones. Growth in height is intensive (girls up to 8 cm, and boys to 12-13 cm). At that time it comes to more intensive growth of extremities so the attitude of the head-torso to the lower extremities changes in favour of lower extremities.

The growth of body mass is proportional to the height (Mišigoj-Duraković, 2008). Growth and strengthening the muscles in this period is the most intensive and at the end of the period it is about 32% of body mass. Growth of vital capacity is also recorded, and there are changes on cardiovascular system because the heart is getting bigger and heart rate is slowing at 80 beats per minute.

Maximum lung ventilation of girls is bigger and it is 80 lit/min at the age of 12/13. Nervous processes are perfected and the process of inhibition is more pronounced (Pavlović, 2006). This age represents the period of more intensive growth of certain motor skills. Therefore, Physical education should be directed primarily to those motor skills of higher sensitivity so the effect would be optimal (Gojković & Radulović, 2010). Knowing sensitive periods of growth of motor skills of students is one of the basic assumptions of planning the teaching of Physical education. There are considerable individual variations which must be taken in consideration. Very often chronological and physiological age do not coincide, which leads to differences among children of the same age, according to some authors up to four years (Beunen, Malina, Lefevre, et al. 1997; Kondrić, Mišigoj-Duraković, & Metikoš, 2002; Milošević, 2008). The research of anthropological status of student population is very often the subject of research in Physical culture and numerous psychosomatic changes typical for this population are the main reason for that (entering puberty).

There are turbulent changes in morphological characteristics and in motor skills at that time (Gajić, 1985; Marušić, Čurović, & Idrizović, 1997; Đurašković, 2002; Georgiev, Aleksandrović, & Petrov, 2009). Sudden changes in growth and development were recorded in morphological characteristics (e.g. height, weight, volumes...), and in motor space there are changes in speed, strength, flexibility, balance and so on. (Jurak, Strel, & Kovač, 2003). Some authors were studying morphological and motor dimensions as segments of anthropological space (Marušić, Čurović, & Idrizović, 1997; Krsmanović, Arunović, & Madić, 1998; Radovanović, Kalajdžić, Raič, & Milošević, 2001) tending to define certain laws considering the acceleration of growth and development, level of motor development, some endogenous and exogenous influences, biological and motor maturity, etc.. A great number of researchers were studying and dealing with the problem of analyzing and defining anthropometric characteristics of children of different school age and their relations (Jakonić, et al. 1998; Dragaš, 1998; Radovanović, Kalajdžić, Raič, & Milošević, 2001; Kondrić, Mišigoj-Duraković, & Metikoš, 2002). Some of them were studying the differences in morphological indicators between sexes of the same age (Despot, & Viski-Štalec, 1983; Ropret, Pajić, Suzović, & Kukolj, 1998; Vučković, & Radovanović, 2011). Furthermore, motor skills were the research subject of a great number of authors (Gajić, 1985; Arunović, Radojević, Bokan, and all., 1998; Radojević, & Radisavljević, 1998; Jurak, Strel, & Kovač, 2003; Kovač, Jurak, Strel, & Bednarik, 2003; Gojković, 2010). Some research was oriented to younger and middle school age while studying motor status of children (Despot et al., 1983; Kukolj, et al., 2001; Pavlović et al., 2008; Kos, Sitar, & Andrović, 2010; Cools, Christiane, & Andries, 2011; Fransen, Pion, & Vandendriessche, 2012).

Most research and analyses studied the same population, from the same environment and background but different social status (Branković, 1998; Kovač, Jurak, Strel., & Bednarik, 2003; Freitas, Maia, Beunen, et al. 2007). Some authors studied differences in this region (morphological and motor) of student population of the same age but different urban or rural areas. (Dragaš, 1998; Nićin, & Kalajdžić, 2000; Krsmanović, Jakonić, Pelemiš, et al., 2000; Reyes, Tan, & Malina, 2000; Kukolj, Bokan, Koprivica, and Ugarković, 2001). The results of their study show the differences which are more pronounced in the area of anthropometric characteristics and mostly in favour of students who live in rural areas (Čeleš, Hadžikadunić, & Hadžikadunić, 2005; Klinčarov, 2005; Petrić, Cetinić and Novak, 2010; Cetinić, Petrić and Vidaković-Samardžija 2011). Beside the abovementioned research and those which were conducted as big state projects a few years ago (Krsmanović, Jakonić, Nićin, & Krsmanović, 1998; Ivanić and Ivanić, 1999) it is still insufficient to discuss this population that is subject to constant changes and influences in the course of their psycho-physical growth. Therefore, it is necessary to carry out occasional small researches which can be pilot projects, in order to permanently monitor student population and make specific corrections regarding regular growth and development of the organism and direct students of this age to do some physical activity and emphasise the importance of Physical education in their proper growth and development. This research, based on the results of previous research concerning differences, treats differences of anthropometric parameters and motor skills of twelve-year students, boys and girls. Research represents a small contribution regarding monitoring and recording psychosomatic changes of the students of this age. The main aim of this research is to confirm and define the differences in segments of morphological and motor space of girls and boys who attend seventh grade of primary schools from different areas. These two spaces are the most responsible for solving motor tasks.

## Methods

### *Sample of examinees*

The sample of examinees defined the population of students, age  $12 \pm 0,5$ , in primary schools in Pale and Mali Zvornik. In total we measured 87 students (47 girls and 40 boys). It is important to point out that all the students took part in the research voluntarily. The obtained results are grouped according to the sexes. Accordingly, the sample of girl's population was unified from these two regions as a subsample and the sample of boys as another subsample.

### *Variables pattern*

For the assessment and confirming the differences of students, nine measuring instruments which defined morphological and motor space were applied: 1. Body height (AVIS-cm), 2. Body mass (AMAS-kg), 3. Deep forward bend on the bench

(MDPK-cm), 4. Long jump (MSDM-cm), 5. Hand tapping (MTAP-iter), 6. Running 4x15m (M4x15-sec), 7. Running 20m high start (M20V-sec), 8. Lifting torso 30sec. (MTR30-iter), 9. Balance (MRV-sec). Applied set of variables was taken from the research Ivanić and Ivanić, (1999). Measuring the anthropological status of students was done by Physical education teachers during the classes of Physical education, in 2011/2012 school years. Statistical data process included basic statistics (arithmetic mean, standard deviation, minimum and maximum results, range of results, skewness and kurtosis). For confirming differences between boys and girls. T-test of big independent samples was applied.

**Results**

In Table 1 there are basic statistical parameters of motor skills and morphological dimensions of researched sample of boys and girls from seventh grade as well as T-test results. Relevant central and dispersion parameters were calculated for each variable. The results of basic statistics show that they are within logically expected range of normal distribution.

Table 1. Statistic parameters for the sample of male (m=40) and female (f=47)

Variables	Sex	Mean	Min.	Max.	Range	St.D	Skew	Kurt.
AMAS (kg)	m	53,88	37,50	83,00	45,50	10,86	,70	,58
	f	50,24	40,00	74,00	34,00	8,19	1,34	2,27
AVIS (cm)	m	161,92	150,00	178,00	28,00	7,23	,76	-,05
	f	161,38	154,00	169,00	15,00	4,22	,32	-,33
MDPK (cm)	m	21,73	10,00	33,00	23,00	5,79	-,06	,21
	f	23,20	15,00	35,00	20,00	4,34	,21	,43
MSDM (cm)	m	156,69	100,00	205,00	105,00	25,16	-,43	-,05
	f	151,29	120,00	180,00	60,00	17,16	-,13	-,96
MTAP (iter)	m	42,81	30,00	53,00	23,00	6,27	-,34	-,79
	f	44,10	29,00	52,00	23,00	6,06	-,85	,41
M4X15 (sec)	m	15,18	13,23	18,54	5,31	1,23	1,06	1,02
	f	15,65	14,09	18,88	4,79	1,02	1,34	4,18
M20V (sec)	m	5,91	5,14	8,20	3,06	,63	2,10	6,17
	f	6,01	5,12	6,93	1,81	,506	,29	-,76
MRV (sec)	m	6,05	2,46	22,63	20,17	4,60	2,33	6,23
	f	7,36	2,84	23,58	20,74	5,92	1,85	2,79
MTR30 (iter)	m	20,31	12,00	30,00	18,00	4,37	,22	,12
	f	17,57	14,00	24,00	10,00	2,74	,83	,07

Mean (average value), standard deviation (St.Dev), Min-Max (minimal and maximal result), Skew (skewness), Kurt (kurtosis)

By the insight in the Table 1. We can conclude that boys were more successful in explosive strength tests (MSDM= 156,69cm), speed endurance (M4x15= 15,18sec), speed (M20V= 5,91sec) and repetitive strength (MTR30''= 20,31iter). Girls achieved better results in tests of flexibility (MDPK=23,20cm), speed of alternative movements (MTAP= 44,10) and balance test (MRV= 7,36).

Boys were of higher average body mass (AMAS= 53,88kg) than girls (AMAS= 50,24kg) while their average body height was almost equal (boys= 161,92cm; girls= 161,38cm). By analyzing the differences of arithmetic means (T-test) between boys and girls (Table 2) considerable differences of 90% of all measured variables were recorded. Presented in percentage, those differences are 50% in favour of boys and 30% in favour of girls.

Table 2. Average values (Mean), standard deviations (St.Dev), minimum (Min) and maximum (Max) values of boys and girls, T-tests results, level of significance (p-level)

Variables	Female			Male			T-test	p-level
	Mean ±St.D	Min	Max	Mean ±St.D	Min	Max		
AVIS (cm)	161,38 ±4,22	154,00	169,00	161,92 ±7,23	150,00	178,00	-1,05	0,30
AMAS (kg)	50,24 ±8,19	40,00	74,00	53,88 ±10,86	37,50	83,00	-1,67	0,010*
MDPK (cm)	23,20 ±4,34	15,00	35,00	21,73 ±5,79	10,00	33,00	1,07	0,29
MSDM (cm)	151,29 ±17,16	120,00	180,00	156,69 ±25,16	100,00	205,00	-,80	0,43
MTAP (iter)	44,10 ±6,06	29,00	52,00	42,81 ±6,27	30,00	53,00	,30	0,76
M4x15 (sec)	15,65 ±1,02	14,09	18,88	15,18 ±1,23	13,23	18,54	1,52	0,13
M20V (sec)	6,01 ±5,0	5,12	6,93	5,91 ±5,63	5,14	8,20	-,50	0,62
MRV (sec)	7,36 ±5,92	2,84	23,58	6,05 ±4,60	2,46	22,63	1,53	0,13
MTR30 (sec)	17,57 ±2,74	14,00	24,00	20,31 ±4,37	12,00	30,00	-3,01	0,004**

Mean (average value), standard deviation (St.Dev), coefficient of t-test value (T-value), significance level (Sig.\* p<0,05; Sig. \*\*p<0,01)

Only the body height recorded the insignificant difference so we can say that in that measure of morphological space, boys and girls were very homogenous. By inspecting the values of T-test of defined variables, statistically significant differences were recorded only in two variables. The first difference is responsible for body mass of the examinees (AMAS, p<0,05), in favour of boys. The second variable is the test of repetitive strength MTR30 (p<0,01), where statistically considerable difference was recorded in favour of boys. The other seven variables did not record the given level of statistical significance, where p-level goes from 0,132 to 0,620.

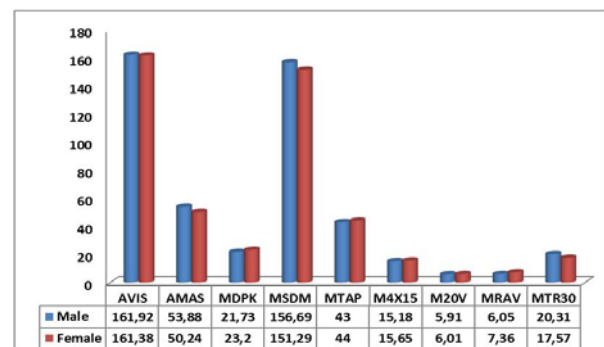


Figure 1. Differences of middle values of male and female

**Discussion**

Based on various results of the previous research, this research was also carried out with the aim to confirm the differences in segments of morphologic and motor space of the twelve-year old students. By analyzing the collected data, we obtained the results that show mentioned differences between boys and girls in all variables. However, statistically considerable differences were only confirmed at variable of body mass (AMAS) and the variable that assessed repetitive strength (MDTR30''). All the others were at the border of statistical significance.

The obtained results of this research were contrary to the results of Harasin, Petrić and Ogrizek (2011) who did not confirm statistically considerable differences in their research among twelve-year old students in anthropometric indicators but the considerable differences were confirmed in manifestation of explosive strength such as long jump which coincides with the results of the research (Klinčarov, 2005). In our case, boys were more successful in tests of explosive strength, speed endurance, speed and repetitive strength, they even had bigger body mass than girls. In contrast, girls achieved better results in tests of flexibility, speed of alternative movements and balance test. A comparative analysis shows domination of boys in motor and partly morphological space in comparison to girls, which was also confirmed in previous researches analyzed in this area (Jakonić, Krsmanović, Krsmanović, & Bačlić, 1998; Ivanić, & Ivanić, 1999; Klinčarov, 2005; Gojković, 2010; Gojković and Radulović, 2010). However, certain researches negated the domination of boys in comparison to girls when it is about morphological space (Despot, & Viski-Štalec, 1983; Radojević, & Radisavljević, 1998; Krsmanović, Jakonić, Pelemiš, Jasnić, & Dolga, 2000; Kondrić, Mišigoj-Duraković, & Metikoš, 2002), where the girls were quite superior in comparison to boys, especially in body mass and very often in body height (Radojević, & Radisavljević, 1998). This research supports the results of studying motor skills (Metikoš, 2002; Pavlović, Marković, Branković, & Kocić, 2008; Neljak, Novak, & Podnar, 2011) where the girls showed motor superiority in comparison to boys, especially concerning flexibility, balance and segmentary speed. The differences between these two subsamples are evident and there is no doubt in that, and the consequences are exactly psychophysical changes manifested in pre-puberty and puberty stage. The variables which achieved statistically considerable difference are body mass from the space of morphology, in favour of boys (AMAS= -0,010\*) and only one variable which assessed repetitive strength of torso, from motor space (MTR30"=0,004\*\*), also in favour of boys. Previously obtained results of the research on this population, which are analyzed and enable making valid conclusions, are different. Considerable differences between good and poor results in motor tests of boys and girls can be attributed to the fact that certain factors had the main role in this area. Those factors are previous motor experience, doing some physical activity or activity in a sports club, which could increase result efficiency of execution of tests. We can also mention CNS maturation, numerous exogenous and endogenous factors. Among endogenous factors, heredity has the main role in body growth and development. The sex also has a great influence on growth and development. Most properties differ in childhood of males and females and changes are more pronounced in adults (Đurašković, 2002). Endocrine glands and their functions are the third very important endogenous factor. Important exogenous factors are geographic and climate factors.

Moreover, social and economic factors in a series of tests conducted all over the world, show that body growth and development in economically stronger families are better on average than of the children who come from poorer families (e.g. height, weight). The difference is conditioned by the quality of food, housing conditions, social and hygienic factors. This phenomenon was marked as acceleration in growth and it is characterized by numerous indicators. Health condition is also primary exogenous factor which is manifested through some acute and lighter chronic diseases and lighter injuries which do not leave more considerable consequences on growth and development. A very important exogenous factor is physical activity and workout, because it is well known that physical activities carried out through game give substantial contribution to regular growth and development of children. Physical exercises develop muscles, increases the amount of muscles, strengthen connections and joints. For proper application of physical exercises it is necessary to know the influence of exercises on the development of heart, blood circulation and breathing (Jakonić and Bajić, 1996) in order not to impair proper growth and development of young organism by physical activity.

### Conclusion

The research was realized according to the sample of 87 students between 12 years±6 months, with the aim of confirming the differences between boys and girls in morphological and motor space. By analyzing the results, the difference of arithmetic mean of the tested measures of defined spaces, significant differences of all measures were recorded. However, only in two cases the difference is statistically important at the level ( $p < 0.05$ ;  $p < 0.01$ ), which represents 29% of differences from the total number of measured variables. Those differences were recorded in body mass (AMAS,  $T = -1,67^*$ ) and repetitive strength (MDT30",  $T = -3,01^{**}$ ) in favour of boys who had higher or lower values depending on the measured variable, while in the other measures those differences are minimal and almost identical. Boys were more successful in 66% of variables. They were taller (AVIS), heavier (AMAS), better in explosive strength (MSDM), speed endurance (4x15), running speed (M20V), and repetitive strength (MDT30"). Girls achieved better result in flexibility measures (MDPK), segmentary speed (MTAP) and balance (MRAV), which represent 34%. In conclusion we can say that morphologic and motor space at the stage of turbulent psychosomatic changes, because it is assumed that not all examinees are in puberty, and that they were subject to certain modifications and transformations in positive direction of boys and slightly less of girls. Even though we are talking about the same age, the same motor tests, changes are obvious. Sometimes it is more pronounced, sometimes less, but it is important. These results show still insufficiently differentiated spaces regarding the sex, but there are some indicators where they could be possible in the subsequent age periods.

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## RAZLIKE SEGMENTA MORFOLOŠKIH I MOTORIČKIH PROSTORA SREDNJOŠKOLACA

### Sažetak

Dijagnostika učenika u tjelesnom odgoju je važna zbog razvoja plana i programa rada kao i nadzora i uvida u njihovo sadašnje stanje. Jasno je da individualne razlike tijekom rasta i razvoja doprinose varijabilnosti funkcija i sposobnosti čovjeka i stoga je važno pratiti i procijeniti karakteristike i sposobnosti pojedinih subjekata. Morfološke karakteristike su neizbježan dio u dijagnostici motornih vještina i vrlo često su predmet znanstvenih istraživanja. Prostor morfoloških karakteristika i motoričkih sposobnosti dječaka i djevojčica iz srednje škole analizirane su u radu s ciljem potvrđivanja razlike u pogledu spola. Izmjereno je devet varijabli koje definiraju morfološki prostor (2 varijable) i motorički prostor (7 varijabli). U analizi podataka uz primjenu T-test smo dobili rezultate koji znanstveno objašnjavaju razlike među učenicima ( $P < 0,05$ ;  $p < 0,01$ ). Samo u dvije varijable te razlike su statistički značajne u korist dječaka ( $A_{mas} = -0,010$  \*) i ( $MTR30 = 0,004$  \*\*).

**Ključne riječi:** faze rasta, morfološke značajke, motoričke sposobnosti, razlike

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