GENDER DIFFERENCES IN BODY COMPOSITION AND MOTOR SKILLS OF MIDDLE AGE SCHOOL STUDENTS

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Abstract: *The goal of this research was to determine whether there is a gender difference in body composition and motor skills of middle school age students. A total of 84 respondents, female and male seventh grade elementary school students, with an average age of 12.9 years, participated in this research. In the research, it was studied whether there is a gender difference in the parameters of body composition and motor skills. Body composition was assessed by measuring body height (BH), body mass (BM), body mass index (BMI), percentage of fat tissue (BF%) and percentage of muscle tissue (MM%). Flexibility tests were used to assess motor skills: supine forward lunge (LRSP) and sitting forward bend (Sit-and-Reach), to assess explosive power: vertical squat jump (SJ), to assess speed: 30m sprint (SPR30), with passing time at 5m (SPR5) and 10m (SPR10). T-test (TT) was used to assess agility, while "Shuttle run - 20m" (VO^2max) was used to assess cardiorespiratory endurance. In order to determine the gender differences in body composition and motor skills of the respondents, Analysis of Variance was used at the multivariate and univariate levels. After analyzing the obtained results, it was proven that there are statistically significant gender differences in body composition and motor skills of middle age school students.*
Key words: *body composition, motor skills, gender differences, middle age school students*

INTRODUCTION

The primary goal of physical education classes is to positively influence the psychosomatic status of students through an organized teaching process and to correct the effects of biological factors, which have been found to be insufficient during periods of intensive growth and development, through the transformation of somatic status. Physical education plays a significant role in the education of individuals, aiming to contribute to the optimal development of their abilities through physical activities, as well as fostering the growth and enhancement of their physical capabilities and psychosocial characteristics (Hardman, 2007). A harmonious development of students' physical abilities creates realistic conditions for the successful realization of other tasks within this educational field, as defined by program documents, including the adoption of sports-technical education content appropriate to the age and gender of the students. The sports-technical education of students should be based on a well-established "motor foundation-" i.e., good physical fitness, which implies the harmonious development of all motor skills.

Physical education, its practical and educational focus, and the results achieved through it represent a highly complex phenomenon that requires planned and systematic study of all its aspects and components to optimize the teaching process (Anastasovski et al., 2000).

Regular physical activity during childhood provides immediate health benefits, which are reflected in a positive impact on body structure and composition, the development of the muscular and skeletal systems, and the functional abilities of students (Malina & Bouchard, 1991). However, physical education classes do not deliver the expected results.

The curriculum for physical education for students from the fifth to the eighth grade of primary school, prescribed by the Ministry of Education (Official Gazette of the Republic of Serbia, no. 6/2007), includes three weekly lessons: two regular physical education lessons aimed at achieving the objectives and content of the core curriculum and one lesson per week dedicated to elective sports activities within the teaching of a chosen sport.

According to the curriculum for primary education prescribed by the Ministry of Education, the goal of "Physical Education – Selected Sports" is to contribute to achieving the objectives of physical education

as an integral part of the educational system as a whole through diverse and systematic sports training and practice, while also meeting the individual needs of students, their curiosity, and their desire for achievement in the chosen sport.

The specific operational tasks of elective classes are primarily focused on the development of motor skills and the acquisition and improvement of motor knowledge and habits that are dominant in the teaching of the chosen sport, such as speed, strength, endurance, flexibility, coordination, and agility, starting from the individual capabilities of students (Stojanović, 1998). It is expected that, through the content of elective physical education classes, students will be able to apply the acquired technical and tactical knowledge and skills of the chosen sport in complex conditions (through games and competitions).

METHODS

Sample of Participants

The sample for this research was drawn from the population of seventh-grade primary school students. The sample was divided into two groups: G1 – Female Students (n=41) and G2 – Male Students (n=45).

Measurement Instruments

Body Composition

For the purposes of this study, the following body composition parameters were tested:

- Body Height (BH) (cm),
- Body Weight (BW) (kg),
- Body Mass Index (BMI) (kg/m^2),
- Body Fat Percentage (BF%) (%) and
- Muscle Mass Percentage (MM%) (%).

Motor Skills

To assess motor skills, a battery of six tests was used:

- Leg Raise from Supine Position (LRSP) (°);
- Sit-and-Reach (cm);
- Squat Jump (SJ) (cm);
- 30m Sprint with Split Times at 5m and 10m (SPR5, SPR10, SPR30) (s);
- T-Test (TT) (s) and
- 20 m Shuttle Run (VO^{2}max) (mL·kg^{-1}·min^{-1})

Data Analysis

Descriptive statistical procedures were applied to analyze basic statistical data and the distribution of results. To test differences in body composition and motor skills between female and male of middle age school students, multivariate analysis of variance (MANOVA) and univariate analysis of variance (ANOVA) were applied. The significance level was set at $p < 0.05$. The data were processed using the statistical software package STATISTICA 12.0 for Windows (StatSoft, Inc., Tulsa, OK).

RESULTS

Based on the descriptive parameters of body composition for the female and male student groups (Tables 1 and 2), it is evident that all measurement results fall within the range of a normal distribution. For each variable, the following values are presented: arithmetic mean (Mean), minimum (Min.) and maximum (Max.) achieved result, standard deviation (Std. Dev.), skewness (Skew.), and kurtosis of the result distribution (Kurt.).

Table 1 Descriptive Statistics for Body Composition Variables – **Female**

Variable	N	Mean	Min.	Max.	Std.Dev.	Skew.	Kurt.
BH (cm)	41	159.50	145.30	172.10	5.76	0.18	0.28
BW (kg)	41	50.34	33.50	79.60	8.98	0.70	1.64
BMI (kg/m2)	41	19.73	14.48	32.29	3.13	1.66	5.51
BF% (%)	41	22.35	9.90	42.20	7.15	0.40	0.11
MM% (%)	41	34.32	27.60	38.10	2.21	-0.72	0.88

Legend: N – sample; Mean – arithmetic mean; Min – minimum result values; Max – maximum result values; Std.Dev. – standard deviation; Skew. – skewness of the result distribution curve; Kurt. – kurtosis of the result distribution curve.

Table 2 Descriptive Statistics for Body Composition Variables – **Male**

Variable	N	Mean	Min.	Max.	Std.Dev.	Skew.	Kurt.
BH (cm)	45	165.12	147.20	190.60	8.74	0.43	0.51
BW (kg)	45	55.72	38.70	77.90	9.55	0.68	-0.28
BMI (kg/m2)	45	20.36	16.43	25.61	2.51	0.24	-0.90
BF% (%)	45	17.67	5.60	33.60	7.16	0.37	-0.54
MM% (%)	45	38.56	32.80	43.60	2.96	-0.28	-0.56

The results of the multivariate differences in body composition between female and male middle age school students are presented in Table 3. The results indicate statistical significance at the multivariate level, as the F-test values are exceptionally high, reaching 70.9, with significance at the level of Q=0.000.

Table 3 Multivariate Differences in Body Composition Between **Female** and **Male** Students

Wilks Lambda	F	Effect - df	Error - df	Q
0.184	70.9	5	80	**0.000***

Legend: Wilks' lambda – value of the Wilks' test coefficient for group centroid equality; F – value of the F-test coefficient for the significance of Wilks' lambda; Effect df – degrees of freedom for the effect; Error df – degrees of freedom for the error; Q – coefficient of centroid significance.

At the univariate level, where the results are presented in Table 4, it can be observed that the differences in body composition are primarily attributed to the muscle mass percentage – MM% (F=55.78, p=0.000) and body height – BH (F=12.14, p=0.001), where the male students had higher values compared to the female students, which was expected. In measures of body weight – BW (F=7.22, p=0.009), male students also had significantly higher values, indicating that greater body height and muscle mass contribute to higher body weight in male students. For the body fat percentage – BF%, the female students achieved higher values (F= 9.19, p=0.003), and this difference is statistically significant and numerically visible (20.9%), highlighting a considerably higher percentage of fat mass in female students compared to male students.

Table 4 Univariate Differences in Body Composition Between **Female** and **Male** Students

Variable	G1 - G2	%Δ	F (1; 84)	p
BH (cm)	-5.62	-3.5	12.14	**0.001***
BW (kg)	-5.38	-10.7	7.22	**0.009***
BMI (kg/m2)	-0.63	-3.2	1.08	0.302
BF% (%)	4.68	20.9	9.19	**0.003***
MM% (%)	-4.24	-12.4	55.78	**0.000***

Legend: G1 - G2 – difference in mean values between groups; %Δ – difference in mean values between groups in percentages; * – statistically significant differences.

Based on the descriptive parameters of motor skills for the groups of female and male students (Tables 5 and 6), it can be observed that the results for all measurements fall within the range of a normal distribution. For each variable, the following values are presented: arithmetic mean (Mean), minimum (Min.) and maximum (Max.) achieved result, standard deviation (Std.Dev.), skewness (Skew.), and kurtosis of the result distribution (Kurt.).

Tabel 5 Descriptive Statistics for Motor Skills Variables - **Female**

Variable	N	Mean	Min.	Max.	Std.Dev.	Skew.	Kurt.
LRSP (*o*)	41	89.63	69.00	126.00	14.39	0.84	0.61
Sit-and-Reach (cm)	41	23.01	11.20	35.10	6.95	0.17	-1.12
SJ (cm)	41	19.12	12.30	28.10	3.45	0.40	0.07
SPR5 (*s*)	41	1.38	1.15	1.73	0.16	0.23	-0.92
SPR10 (*s*)	41	2.32	1.94	2.79	0.23	0.16	-0.78
SPR30 (*s*)	41	6.06	5.02	7.71	0.61	0.92	0.69
TT (*s*)	41	14.72	11.24	17.99	1.58	0.13	-0.26
VO^2max ($mL \cdot kg^{-1} \cdot min^{-1}$)	41	27.33	18.92	38.49	5.58	0.61	-0.73

Legend: N – sample; Mean – arithmetic mean; Min – minimum result values; Max – maximum result values; Std.Dev. – standard deviation; Skew. – skewness of the result distribution curve; Kurt. – kurtosis of the result distribution curve.

Tabela 6 Descriptive Statistics for Motor Skills Variables - **Male**

Variable	N	Mean	Min.	Max.	Std.Dev.	Skew.	Kurt.
LRSP (*o*)	45	83.49	48.00	115.00	14.81	0.08	-0.35
Sit-and-Reach (cm)	45	14.90	0.00	26.30	6.82	-0.10	-0.86
SJ (cm)	45	23.00	8.90	30.90	4.72	-0.57	0.67
SPR5 (*s*)	45	1.29	1.06	1.59	0.13	0.09	-0.78
SPR10 (*s*)	45	2.15	1.85	2.53	0.19	0.04	-1.02
SPR30 (*s*)	45	5.49	4.69	6.51	0.44	0.22	-0.57
TT (*s*)	45	13.51	10.49	17.72	1.78	0.14	-0.72
VO^2max ($mL \cdot kg^{-1} \cdot min^{-1}$)	45	32.28	20.44	44.93	6.57	-0.28	-0.96

The results of the multivariate differences in motor skills between female and male students are presented in Table 7. The results indicate statistical significance at the multivariate level, as the F-test values are high, reaching7.36, with significance at the level of Q=0.000.

Tabel 7 Multivariate Differences in Motor Skills Between **Female** and **Male** Students

Wilks Lambda	F	Effect - df	Error - df	Q
0.508	9.31	8	77	**0.000***

Legend: Wilks' lambda – value of the Wilks' test coefficient for group centroid equality; F – value of the F-test coefficient for the significance of Wilks' lambda; Effect df – degrees of freedom for the effect; Error df – degrees of freedom for the error; Q – coefficient of centroid significance.

At the univariate level, where the results are presented in Table 8, it can be observed that the greatest contributors to the differences in motor skills are the Sit-and-Reach (F=29.78, p=0.000), Sprint – 30M (F=24.04, p=0.000), and SJ (F=18.59, p=0.000). Slightly lower levels of differences were observed in the other variables: Sprint – 10M (F=14.24, p=0.000), Cardiorespiratory Endurance – VO^2max (F=14.04, p=0.000), T-test (F=11.06, p=0.001), and Sprint – 5M (F=8.66, p=0.004). In the Leg Raise from Supine Position – LRSP, no statistically significant difference between the groups was observed; however, on a

numerical level, it can be noted that female students achieved 6.9% better results compared to male students.

When analyzing all motor skill results, it is evident that male students achieved statistically significantly better results in cardiorespiratory endurance, speed, agility, and explosive strength, while female students were dominant in flexibility, particularly in the Sit-and-Reach test, where they achieved 35.2% better results than the male students.

Tabela 8 Univariate Differences in Motor Skills Between **Female** and **Male** Students

Variable	G1 - G2	%Δ	F (1; 41)	p
LRSP (*o*)	6.14	6.9	3.79	0.055
Sit-and-Reach (cm)	8.11	35.2	29.78	**0.000***
SJ (cm)	-3.88	-20.3	18.59	**0.000***
SPR5 (s)	0.09	6.5	8.66	**0.004***
SPR10 (s)	0.17	7.3	14.24	**0.000***
SPR30 (s)	0.57	9.4	24.04	**0.000***
TT (s)	1.21	8.2	11.06	**0.001***
VO^2max ($mL \cdot kg^{-1} \cdot min^{-1}$)	-4.95	-18.1	14.04	**0.000***

Legend: G1 - G2 – difference in mean values between groups; %Δ – difference in mean values between groups in percentages; * – statistically significant differences.

DISCUSSION

The results of differences in body composition between female and male students, presented in Tables 3 and 4, indicate statistically significant differences at both the multivariate and univariate levels, with statistically significant differences observed in almost all variables. Female students achieved lower results, except in the body mass index (BMI), where no significant differences were observed.

In the body height variable – BH (Mean=159.50±5.76), female students were statistically significantly shorter by 5.62 cm or 3.5% compared to male students (Mean=165.12±8.74). The arithmetic mean values for female students are similar to those found in studies conducted on the same population. Slightly higher body height values for female students were observed in Milanović (2011) study (Mean=163.27±6.28), while similar values were reported by Sibinović (2015) (Mean=161.16), Mandarić (2003) (Mean=161.6±2.50), and Zegnal-Koretić (2017) (Mean=159.0±0.68). The average height of female students in our study aligns with reference values for this age group according to Fitnessgram (Milanović, 2011) and the Institute for Sport (Gajević, 2009). The arithmetic mean values for male students are also similar to those found in other studies on the same population. Slightly higher body height values were observed in Milanović (2011) (Mean=168.11±9.62), while similar values were found in Palić et al. (2015) (Mean=165.29±7.06) and Gajević (2009) (Mean=166.07±8.51).

For body weight – BW, female students had statistically significantly lower values (Mean= 50.34±8.98) by 5.38 kg or 10.7% compared to male students (Mean= 55.72±9.55). Similar average body weight values for female students were reported in Mandarić (2003) study (Mean=49.4±3.1), while slightly higher values were noted in other studies (Milanović, 2011; Sibinović, 2015; Zegnal-Koretić, 2017). In general, the average body weight values for female students in our study fall within the reference range for the examined sample (Gajević, 2009). Similar body weight values for male students were reported by Gadžić (Mean=55.6±8.55) and Palić et al. (2015) (Mean=56.0±12.19). Overall, the average body weight values are within the reference norms for the examined sample (Gajević, 2009).

In the body mass index (BMI) variable, female students had slightly lower values (Mean=19.73±3.13) by 3.2% compared to male students (Mean=20.36±2.51). This difference resulted from the significant intergroup difference in body weight – BW. The observed average values for female students are somewhat lower compared to previous studies (Milanović, 2011; Sibinović, 2015; Zegnal-Koretić, 2017), while the values for male students are very similar to those reported in the aforementioned studies and fall within the reference range for the examined sample according to Fitnessgram (Milanović, 2011) and

the Institute for Sport (Gajević, 2009).

For the body fat percentage – BF%, a statistically significant difference of 4.68% was observed, with female students having higher values compared to male students. The average values for both groups fall within the reference range of Fitnessgram (BF%=13.4-27.7) according to Milanović (2011). However, considerably higher results obtained by bioelectrical impedance were noted in Zegnal-Koretić (2017) (Mean=25.93±9.67) and Sibinović (2015) (Mean=25.78).

In the muscle mass percentage – MM%, female students had statistically significantly lower values, with a difference of 4.6% compared to male students. The average values for female students (Mean=34.32±2.21) align with those reported by Sibinović (2015) for the same population (E: Mean =34.04; K: Mean=33.54). For male students, the mean value was (Mean=38.56±2.96).

Based on the analysis of descriptive parameters and the observed differences between the groups in body composition, it can be concluded that statistically significant differences were found in four variables. These results indicate that female students have significantly lower values in body height, body weight, and muscle mass percentage, while they have significantly higher values in the body fat percentage. In the body mass index, only numerical differences were observed, with no substantial deviations, where female students had slightly lower values. The obtained results are similar to those reported in previous studies that examined seventh-grade students, suggesting that the results do not deviate from the reference norms for the examined sample.

The results of the differences in motor skills between female and male students, presented in Tables 7 and 8, indicate statistical significance at both the multivariate and univariate levels. Male students showed significantly better results in variables assessing the vertical jump – SJ (20.3%), cardiorespiratory endurance – VO^2max (18.1%), SPR30 sprint speed (9.4%), acceleration speed at SPR5 (6.5%) and SPR10 (7.3%), as well as agility TT (8.2%). Female students achieved significantly better results in tests assessing flexibility, specifically in the Sit-and-Reach test (35.2%) and the Leg Raise from Supine Position – LRSP (6.9%).

The Sit-and-Reach test used in this study, part of the Eurofit battery of tests, allowed for comparisons with previous domestic research, as the Eurofit battery is the official test for monitoring student growth and development in Serbia. The average measured values for female students in this test (Mean=23.01±6.95) are very similar to those found in studies on the same population, such as Sibinović (2015) (E: Mean=25.84±5.92; K: Mean=23.6±5.32) and the Institute for Sport (Gajević, 2009) (Mean=21.89±9.20). The results for male students (Mean=14.90±6.82) are similar to those reported by Milanović (2011) (Mean=14.42±6.57) and the Institute for Sport (Gajević, 2009) (Mean=15.26±7.59).

In the test for assessing cardiorespiratory endurance – VO^2max, the mean values for female students (Mean=27.33) were very similar to those in study by Sibinović (2015), where female students in the experimental group achieved slightly higher values (Mean=29.69), 11.6% better than the control group (Mean=26.26). Slightly higher values (Mean=32.34) were reported by Zegnal-Koretić (2017) in a study conducted on a sample of 136 female students from Croatia. For male students, the level of cardiorespiratory endurance (Mean=32.28) is categorized as very poor according to the reference norms for the 13-19 age group (Heyward, 1998).

Cardiorespiratory endurance is an important indicator of health status, both for individuals and the general population, particularly for school-age children. It directly correlates with the level of physical activity and negatively correlates with excess body weight (Ara et al., 2007). Therefore, monitoring VO^2max results for this age group is of great importance.

The obtained results are consistent with those reported in previous studies on seventh-grade students, indicating that they do not significantly deviate from normative age characteristics.

CONCLUSION

Based on the defined objectives, tasks, and the obtained results after measuring body composition and using a battery of six tests for assessing motor skills, adequate statistical analysis allowed for identifying differences between female and male students in the studied domains. The results indicate significant differences in body composition, where male students achieved better results in most

measures. Significant differences in motor skills show that male students had considerably higher values in speed, explosive strength, agility, and cardiorespiratory endurance, while female students were superior in flexibility.

The results of this study can be used by physical education teachers to monitor body composition and motor skill development in their students. Additionally, future studies using the same battery of tests and sample could utilize these data for comparisons and tracking changes in the examined characteristics.

The practical contribution of this research lies in enabling parents and teachers to influence changes in body composition, ultimately aiming to improve motor status. The results can also serve as a basis for other studies examining the relationship between body composition and motor skills, providing more precise insights into the positive effects of muscle mass and the negative impact of increased body weight, BMI values, and fat percentage on performing motor tasks.

The general conclusion is that further research with larger sample sizes is needed to gain a better understanding of the body composition and motor skill development of middle age school students, from the youngest to the oldest categories. According to these findings, male students should focus on improving flexibility, while female students should work on optimizing body composition by increasing muscle mass, reducing fat tissue, and enhancing overall motor abilities.

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POLNE RAZLIKE TELESNOG SASTAVA I MOTORIČKIH SPOSOBNOSTI UČENIKA SREDNJEG ŠKOLSKOG UZRASTA

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Sažetak: *Cilj ovog istraživanja je bio da se utvrdi da li postoji polna razlika telesnog sastava i motoričkih sposobnosti učenika srednjeg školskog uzrasta. Ukupno 84 ispitanika, učenika sedmog razreda osnovne škole ženskog i muškog pola, prosečne starosti 12,9 godina, učestvovalo je u ovom istraživanju. U istraživanju je proučavano da li postoji polna razlika u parametrima telesnog sastava i motoričkih sposobnosti. Telesni sastav je procenjivan merenjem telesne visine (BH), telesne mase (BW), indeksa telesne mase (BMI), procenta masnog tkiva (BF%) i procenta mišićnog tkiva (MM%). Za procenu motoričkih sposobnosti korišćeni su testovi fleksibilnosti: prednoženje iz ležanja na leđima (LRSP) i pretklon u sedu (Sit-and-Reach), za procenu eksplozivne snage: vertikalni skok iz čučnja (SJ), za procenu brzine: sprint na 30m (SPR30), sa prolaznim vremenom na 5m (SPR5) i 10m (SPR10). Za procenu agilnosti korišćen je T-test (TT), dok je za procenu kardiorespiratorne izdržljivosti primenjen test trčanja na 20m sa progresivnim opterećenjem "Shuttle run – 20m" (VO^2max). Kako bi se utvrdile polne razlike telesnog sastava i motoričkih sposobnosti ispitanika, korišćena je Analiza varijanse na multivarijantnom i univarijantnom nivou. Nakon analize dobijenih rezultata dokazano je da postoje statistički značajne polne razlike telesnog sastava i motoričkih sposobnosti učenika srednjeg školskog uzrasta.*

Ključne reči: *telesni sastav, motoričke sposobnosti, polne razlike, učenici srednjeg školskog uzrasta*