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Body Composition of Early Adolescent Boys and Girls in Montenegro: National Analysis with the Regional Review

Composición Corporal de Niños y Niñas Preadolescentes en Montenegro: Análisis Nacional con Revisión Regional

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SUMMARY: This research analyzed the body composition of Montenegrin boys and girls of early adolescent age, with a special focus on regional differences between the northern, central and southern regions of Montenegro. The sample included 2000 subjects (1028 boys (11.75±0.33 years) and 972 girls (11.72±0.31 years), which represents about a quarter of the population of the mentioned age group. The investigated variables were body height, body weight, percentage of body fat and body mass index (BMI, percentiles), measured by bioelectrical impedance (Omron BF511) according to ISAK standards. The results showed that boys and girls from the northern region have statistically significantly lower body height values compared to their peers from the central and southern regions. Higher BMI percentiles and a higher percentage of body fat compared to the central region were recorded in boys, while no significant differences in BMI, body weight or percentage of fat between regions were found in girls. The majority of respondents were in the category of normal nutrition (about 62 % of boys and 72 % of girls), while about a third of boys and a quarter of girls had elevated BMI values. The obtained findings indicate the existence of regional differences in body height and body composition that may be related to socioeconomic, nutritional and environmental factors. The results confirm the need for systematic monitoring of the nutritional status of children and adolescents, the development of preventive programs, and the promotion of physical activity and healthy eating habits in the school environment.

KEY WORDS: Body composition; Early adolescence; Boys; Girls.

INTRODUCTION

The period of adolescence is characterized by numerous sensitive changes that include physical, psychological, hormonal, cognitive, social and emotional development of the individual. Although this life stage is considered the healthiest, it also carries a paradoxical increase in the risk of morbidity and mortality (Sawyer *et al*., 2012; Patton *et al*., 2016). Precisely because of rapid and often unpredictable changes, adolescence should be a priority in any preventive plan, both from a clinical and educational perspective, with the aim of encouraging healthy development of young people and improving health and well-being in adulthood Mastorci *et al*. (2021). During this period, a faster increase in body height, weight gain, lean mass and bone mineral content are observed, but the onset of puberty generally begins earlier in girls than in boys (Chumlea *et al*., 1983; Vizmanos & Marti-Henneberg, 2000). In girls, regardless of chronological age, development during adolescence is associated with an increase in the percentage of body fat, in contrast to boys, who also have a lower percentage of body fat during that period (Vizmanos & Marti-Henneberg, 2000). However, for boys in the period of adolescence, a decrease in the percentage of body fat, the speed of growth of body height and an increase in shoulder span, the ratio of the length of the legs to the torso are characteristic. Differences in fat mass between the sexes are evident even long before puberty tends to begin (Taylor *et al*., 1997; Vizmanos & Marti-Henneberg, 2000). Such body composition and psycho-sociological changes determine nutritional needs, diet and modification of physical activity. Where it happens that a certain way of behavior and actions of adolescents lead to disturbances in energy balance and nutritional status. Which further shows that obesity, anorexia, nervousness, bulimia or dyslipidemia are important changes that usually occur in that period of life and often persist into adulthood (Attie & Brooks-Gunn, 1989; Moreno *et al*., 2000). Research shows that there are 340 million over nourished and obese children and adolescents aged 5 to 19 in the world (WHO, 2020). Excess

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body fat is associated with harmful metabolic processes and complications, as well as with significant short-term and long-term physical and psychosocial problems (World Health Organization, 1998; Koletzko *et al*., 2002). There are two main causes of obesity in children and adolescents: unhealthy diet and physical inactivity, i.e. inadequate activity. Therefore, it is necessary to find a pattern that will prioritize widespread sports participation through school and extracurricular activities Hainline (2019). One of the important factors that affect the preservation of human health, also reduces the risk of various diseases, is physical activity (Petric *et al*., 2011). A low level of physical activity and a high level of a sedentary lifestyle are associated with the appearance of obesity, that is, with poor metabolic outcomes (Fearnbach *et al*., 2020).

Body composition refers to the proportion of fat and lean tissue in the body, including muscle, bone, water and fat. In children of early adolescent age, the body composition changes dynamically due to accelerated growth and the beginning of puberty changes, during which there are individual variation in the proportion of fat mass and muscle mass, depending on sex, genetic factors and level of physical activity (Malina *et al*., 2004; Wells & Fewtrell, 2006).

The goal of this research is to examine the body composition of Montenegrin boys and girls of early adolescent age, on the basis of which we will obtain significant results in the level of nutrition and observe whether there are significant differences in body composition between children in relation to the region in which they live.

MATERIAL AND METHOD

A sample of respondents

The research was conducted on a sample of 2000 children of early adolescent age, of which 1028 were boys (11.75±0.33 years) and 972 were girls (11.72±0.31 years), which is about 26 % of the total population of the mentioned age in Montenegro. The respondents were selected from different regions (northern, central and southern), which enabled a regional analysis of differences in body composition. In order to better display the results and more clearly and precisely fulfill the objectives of this research, the sample of respondents was divided into the following groups: 1) boys from the northern region (N=278), 2) girls from the northern region (N=265), 3) boys from the central region (N=416), 4) girls from the central region (N=393), 5) boys from the southern region (N=334), 6) girls from the southern region (N=314). The respondents were healthy children who, after being informed about the aims and procedures of the research, voluntarily participated.

A sample of measuring instruments

Body composition in this research is defined as a set of morphological characteristics that quantify the ratio of fat and lean tissue in the body. The following variables were used for its assessment: body height (ATV), body weight (ATT), body fat percentage (ABF), body mass index expressed in percentile values (BMI). Measurements were performed in accordance with ISAK methodology standards (Marfell-Jones *et al*., 2006). Bioelectric impedance (BIA) was used to assess body composition using the OMRON BF511 device, which is approved for use in children over 10 years of age.

Statistical data processing

In order to identify differences in body composition between subsamples in relation to sex and region, a one-factor analysis of variance (ANOVA) was used. For variables where significant differences were found ($p < 0.05$), the LSD post hoc test was performed for additional analysis of pairs of groups.

RESULTS

Table I shows the descriptive statistics of the results of boys from Montenegro. The results are presented in detail by subsamples or regions. In the firstvariable, we observe that the tallest boys are in the central region and the lowest in the northern region. There is a similar variability, slightly higher in the south (Sd=8.94). All distributions have a slight positive asymmetry, which indicates a majority of boys with slightly lower height and a few significantly taller ones. Body weight is uniform between regions (48kg). There is a strong positive asymmetry and a high value of kurtosis especially in boys from the southern region; several boys have a very high value of body weight which indicates possible early signs of obesity. BMI (percentiles) in all three regions had a wide range of values (from ~1 to ~99), with high variability (SD around 30). The average values were slightly higher in the southern (66.47) and northern regions (64.90) than in the central (56.79). The distributions are slightly negatively asymmetric and flatter than normal, which indicates a higher proportion of boys with higher BMI percentiles, but also more evenly distributed results than in the normal curve. The table further shows that the percentage of body fat is the lowest in boys from the central region, and the highest in boys from the northern region. There is a slight positive asymmetry, i.e. a larger number of boys with a lower percentage of fat tissue, along with a few with a higher percentage. The distributions are normal and slightly platy/hyperkurtic, without extreme deviations.

Table I. Descriptive statistics of results, boys.

Variables	Boys	Min	Max	Mean	St. Dev	Sk	Ku
ATV	North	135,0	185,0	154,35	7,61	0,32	0,67
	Central	134,0	182,0	156,56	8,08	0,31	0,24
	South	140,0	187,5	155,73	8,94	0,75	0,65
ATT	North	27,8	98,8	48,95	12,59	0,89	1,13
	Central	27,4	105,8	47,72	11,95	1,17	2,42
	South	31,5	99,5	48,75	11,26	1,54	4,07
BMI (percentile)	North	1	99,99	64,90	31,58	-0,60	-1,03
	Central	1	99,98	56,79	32,51	-0,26	-1,36
	South	3	98,6	66,47	27,15	-0,65	-0,74
ABF	North	5,0	44,7	18,48	9,29	0,45	-0,73
	Central	5,0	41,5	16,07	8,61	0,76	-0,27
	South	5,9	43,5	17,22	7,41	0,84	0,50

Table II shows the descriptive statistics of the results of girls in Montenegro. Analyzing the Table, it can be seen that girls from the central and southern regions have a slightly higher body height compared to girls from the northern region (2.7 cm more on average). The standard deviation is similar in all regions, indicating similar variability. Skewness and kurtosis values are close to zero, which represents a normal distribution of results. The values of the body weight results show that there are minimal differences between the subsamples (0.8 kg difference). Positive skewness symmetry is observed, which indicates that the distributions are slightly skewed to the right, which means that there are more girls with less weight and a few with more. Kurtosis stands out in the subsample of girls from the southern region (1.64), meaning that the distribution is more pointed, that is, the curve is leptokurtic. BMI (percentiles) of girls in all three regions range from 1 to almost 100, with high variability (SD 27–31). Average values are very similar between regions, from 54.97 in the central to 57.85 in the south. The distributions are slightly negatively skewed and flatter than normal, indicating a higher proportion of girls with higher BMI percentiles and a more even growth compared results than in a normal distribution. For the variable percentage of body fat (ABF), the averages and standard deviations are similar. There is a slight positive asymmetry, but also platykurtosis (negative kurtosis), which means that the distribution of the results is "flatter" than normal.

Table II. Descriptive statistics of results, girls.

Variables	Girls	Min	Max	Mean	St. Dev	Sk	Ku
ATV	North	135,0	179,0	154,82	7,93	0,17	-0,04
	Central	136,0	184,0	157,58	8,01	-0,15	-0,13
	South	135,0	180,0	157,02	7,68	-0,11	-0,11
ATT	North	26,3	79,1	47,24	11,63	0,67	-0,12
	Central	24,1	89,6	47,86	11,43	0,82	0,79
	South	27,6	86,1	48,02	10,84	0,95	1,64
BMI (percentile)	North	1	99,5	56,72	31,49	-0,30	-1,27
	Central	1	98,7	54,97	30,59	-0,21	-1,31
	South	1	99,8	57,85	27,70	-0,34	-0,98
ABF	North	5,1	44,9	19,74	9,70	0,51	-0,63
	Central	5,4	44,9	19,49	9,52	0,36	-0,86
	South	5,7	40,3	19,14	8,00	0,50	-0,43

The conclusion based on the analysis of Tables I and II is that for boys and girls in all three regions, all variables show a wide range of values and relatively high variability, which indicates differences between respondents within the same region. The mean values of ATV and ATT are very similar between regions, with a slight positive skewness in the majority, noting a slightly higher proportion of respondents with higher values. BMI (percentiles) show a slight negative skewness and a flatter distribution, meaning that more children are in the higher percentile range, but with a more even distribution than normal. ABF values are on average lower in the central region in boys.

Overall, there are no extreme deviations, but there are slight regional differences that could be the subject of further statistical analysis.

Table III shows the results of the differences between the subsamples of boys, which were obtained using a one-factor analysis of variance ANOVA. Also for variables where significant differences ($p<0.05$) were found, the LSD post hoc test was conducted for additional analysis of pairs of groups.

In Table III, we notice that there are statistically significant differences in three of the four offered variables at the $p<0.05$ level. With the variable body height (ATV), we observe statistically significant results: $F(2.1025)= 5.98$, $p = 0.003$. Subsequent subsample comparisons using the LSD post hoc test show that boys from the northern region are the lowest. Boys from the central region are statistically significantly taller than boys from the northern region ($p=0.001$). Boys from the southern region are statistically significantly taller than boys from the northern region ($p= 0.040$). According to the values of the arithmetic averages, boys from the central region are taller than boys from the southern region, but not statistically significantly. The variable body weight (ATT) has approximately the same values in all three groups, so there are no statistically significant differences, $F(2.1025)=1.13$, $p=0.323$. The next variable showing statistically significant differences between the groups is the body mass index expressed in percentile values (BMI): $F (2.1025)=10.82$, $p=0.001$. The results show that boys from the northern region have higher body mass index values than boys from the central region ($p=0.001$), also boys from the southern region have higher BMI values compared to boys from the southern region ($p=0.001$). There are no statistically significant differences between boys from the northern and southern regions; however, by analyzing the arithmetic values, the boys from the southern region have slightly higher values than the boys from the northern region. Results describing the variable body fat percentage (ABF) show statistically significant results $F (2,1025)=6.81$, $p=0.001$. Group comparisons using the LSD post hoc test show statistically significant differences between the northern and central regions ($p=0.001$), where children from the northern region have a statistically higher percentage of body fat compared to boys from the central region. Boys from the southern region did not show statistically significant differences compared to the other two groups of respondents.

Table IV shows the results of differences between subsamples of girls, one-way analysis of variance (ANOVA) with additional examination of differences between groups by LSD post hoc test. In the table, we observe statistically significant differences in one variable out of the four shown.

The results of the body height variable (ATV) show statistically significant differences: $F(2,969)=10.22$, $p=0.001$. According to the LSD post hoc test, girls from the northern region are significantly lower than girls from the central region ($p=0.001$). Girls from the southern region are statistically significantly taller than girls from the northern region ($p=0.001$). Girls from the central region and the southern region have approximately the same results and statistically do not differ significantly. In other variables, there are no statistically significant differences between the subsamples.

Table III. Results of differences between boys' subsamples (ANOVA, LSD post hoc).

Variables	Region	M ± SD	ANOVA F (df)	p	Significant differences (LSD post hoc)
ATV	North Central South	154,35 ± 7,61 156,56 ± 8,08 155,73 ± 8,94	5,98 (2,1025)	0,003	North < Central (0,001) North < South (0,040)
ATT	North Central South	48,95 ± 12,59 47,72 ± 11,95 48,75 ± 11,26	1,13 (2,1025)	0,323	
BMI (percentile)	North Central South	64,90 ± 31,58 56,79 ± 32,51 66,47 ± 27,15	10,82 (2,1025)	0,001	North > Central (0,001) South > Central (0,001)
ABF	North Central South	18,48 ± 9,29 16,07 ± 8,61 17,22 ± 7,41	6,81 (2,1025)	0,001	North > Central (0,001)

Table IV. Results of differences between girls' subsamples (ANOVA, LSD post hoc).

Variables	Region	M ± SD	ANOVA F (df)	p	Significant differences (LSD post hoc)
ATV	North Central South	154,82 ± 7,93 157,58 ± 8,01 157,02 ± 7,68	10,22 (2, 969)	0,001	North < Central (0,001) North < South (0,001)
ATT	North Central South	47,24 ± 11,63 47,86 ± 11,43 48,02 ± 10,84	0,37 (2, 969)	0,687	
BMI (percentile)	North Central South	56,72 ± 31,49 54,97 ± 30,59 57,85 ± 27,70	0,83 (2, 969)	0,436	
ABF	North Central South	19,74 ± 9,70 19,49 ± 9,52 19,14 ± 8,00	0,31 (2, 969)	0,729	

We analyzed the body mass index variable (BMI percentiles) in more detail and presented the results in Graph 1, where the percentile of boys and girls that belong to a certain nutrition category according to WHO standards is shown (World Health Organization, 2007). As a result, 3.22 % of boys and 4.01 % of girls of the total sample of respondents fall under the malnutrition category, 61.68 % of boys and 71.92 % of girls belong to the group of normally nourished children, while 29.66 % of boys and 20.58 % of girls belong to the group of obese, and 5.44 % of boys and 3.49 % of girls from the total number of samples, fall under the obesity category. Accordingly, a large percentage of respondents are in the category of normal BMI values ??for that age, and a significantly smaller percentage of children are in the category of malnutrition and obesity, thickness (Fig. 1).

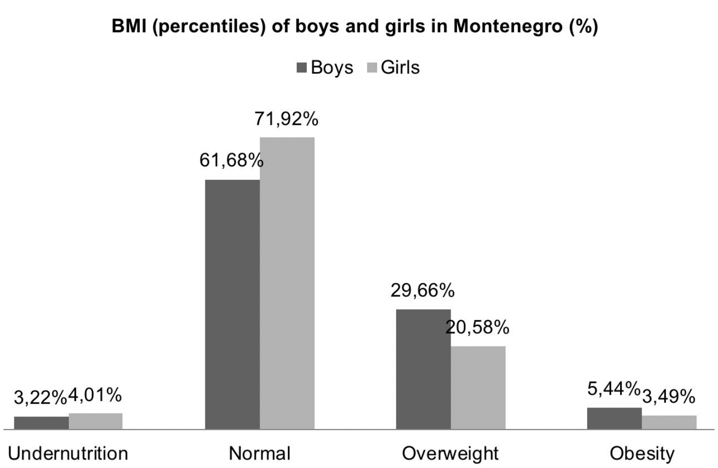

Fig. 1. BMI (percentiles) of boys and girls by category as a percentage of the total sample.

DISCUSSION

The findings of this research provide valuable information on the body composition of children in early adolescence in Montenegro. The sample, which is highly representative for this national study, comprises 26 % of the total population of children, aged boys 11.75 ± 0.33 year and girls 11.72 ± 0.31 years, clearly demonstrating that statistically significant differences exist in several body composition variables, particularly in relation to the geographic region in which children reside.

An analysis of Tables III and IV indicates that, among boys, ANOVA revealed significant interregional differences in multiple body composition parameters. Boys from the northern region exhibited significantly lower ATV values compared to their peers from the central and southern regions, but higher BMI percentiles and a higher percentage of body fat (ABF) in comparison with boys from the central region. No statistically significant regional differences were observed in ATT. Among girls, the ANOVA results indicate that girls from the northern region displayed significantly lower ATV values compared to those from the central and southern regions, while no significant differences were established for BMI percentiles, body fat percentage (ABF), or ATT.

Based on WHO growth percentile charts and tables, which represent internationally accepted standards for growth monitoring in children (World Health Organization, 2007), BMI percentile values observed in this study can be interpreted in relation to region and sex. According to mean values among boys, results were as follows: North 64.90; Central 56.79; South 66.47, with high variability of approximately SD = 30. Nevertheless, these average values suggest that boys across all regions fall within the normal BMI percentile range (5th–85th percentile). Among girls, mean values were: North 56.72; Central 54.97; South 57.85, also accompanied by high variability (approx. SD = 30), indicating that girls across all regions are, on average, within normal BMI ranges.

However, descriptive statistics revealed that results for both sexes ranged between the 1st and 100th percentile, indicating that a subset of children displayed concerning BMI values exceeding risk thresholds for overweight and obesity (boys 35.1 %; girls 24.07 %), as well as children below normative values corresponding to undernutrition (boys 3.22 %; girls 4.01 %). These children require special attention through physical education-based interventions, encouraging greater physical activity and development of healthier lifestyle habits.

Body fat percentage was evaluated using threshold values based on research by McCarthy *et al*. (2006) and Gallagher *et al*. (2000), further classified into four categories by Omron Healthcare. According to the mean results among boys in this study—North 18.48; Central 16.07; South 17.22—the sample demonstrated body fat levels within the expected normative range for this age group (12.6 %–28.5 %). For girls, mean values were North 19.74; Central 19.49; South 19.14, indicating similar results across all subgroups, consistent with normative values for this age and sex (16.3 %–33.1 %).

This research provided insight into the current nutritional status of children in early adolescence. A potential limitation concerns the age range of participants. Had the age interval extended from childhood into adolescence, longitudinal tracking of BMI and body fat trends would have been possible, similarly to findings by Bojanic *et al*. (2024), who demonstrated that among Macedonian boys aged 6–14, average body fat increases slightly from ages 7 to 10, but declines thereafter until age 14, while among girls, body fat increases continuously from age 6 to 14. While this constitutes a methodological limitation, it simultaneously represents an opportunity for future research. It is equally important to highlight the influence of early hormonal changes indicating earlier pubertal onset. Pubertal development comprises several maturation stages (Tanner, 1962), accompanied by a complex series of biological transitions such as growth acceleration and development of secondary sexual characteristics (Moran *et al*., 1999). Contemporary studies often utilize modified Tanner descriptions (Travers *et al*., 1995).

Including an additional variable assessing cardiorespiratory fitness and comparing these results with BMI and BF % would introduce further analytical depth, similarly to findings by Badric *et al*. (2024), who demonstrated that BF % served as a significant predictor of cardiorespiratory fitness (CRF) in school-aged children of both sexes. Maintaining optimal body mass alongside satisfactory CRF should therefore be emphasized as a public health priority.

It is important to emphasize that high BMI does not necessarily indicate excessive fat mass or an unfavorable fat distribution Brann (2008). For that reason, bioelectrical impedance analysis (BIA) is considered a reliable alternative to routine clinical assessments (Wright *et al*., 2008).

The findings indicate considerable regional disparities in body composition parameters among Montenegrin children in early adolescence. Boys and girls from the northern region recorded lower average stature, while boys additionally displayed higher BMI percentiles and higher body fat percentage. These differences may reflect socio-economic, nutritional, and environmental regional characteristics. For instance, research conducted in China demonstrated continuous increases in BMI among children aged 5–19 from 1986 to 2019, closely associated with national economic growth. Specifically, 97 % of BMI variance in boys and 98 % in girls could be explained by GDP growth, providing an evidence-based foundation for preventive policy development (Bu *et al*., 2021).

Findings concerning regional differences in body height, BMI, and fat percentage are consistent with those reported by Katanic *et al*. (2023), who also found that children from northern Montenegro exhibited a higher prevalence of overweight and lower average body height compared with children from central and southern areas.

The observation that BMI percentiles are elevated despite comparable body mass values may be attributed to interregional differences in stature. Lower body height for equal mass yields higher BMI, which aligns with conclusions by Popovic *et al*. (2020), highlighting the importance of using multiple indicators when assessing nutritional status during growth. This corroborates that BMI alone is insufficient for accurate assessment of body composition among children undergoing growth transitions, as also emphasized by Zadarko-Domaradzka *et al*. (2023).

A large-scale WHO-COSI study conducted from 2015 to 2017, involving 203,323 children aged 6–9 across 36 European countries, confirmed considerable geographic variations in height, weight, and BMI. Children from northern Europe were tallest, those from southern Europe heaviest, while children from Central Asia were shortest and lightest. Overall overweight prevalence was 28.7 % in boys and 26.5 % in girls, while undernutrition ranged from 1.9 %–2.5 %. Despite public health efforts, unhealthy body weight remains a persistent challenge in the European Region (Spinelli *et al*., 2021).

Body fat assessment via BIA (Omron BF511) proved practical for large samples; however, literature highlights limitations, including dependency on hydration, time of day, and pubertal stage (Stojanovic, 2019; Sanca *et al*., 2024). It is therefore recommended that future research standardize measurement protocols and validate BIA results using reference methods such as DXA.

Overall, results align with global trends concerning rising prevalence of overweight and obesity among youth (World Health Organization, 2024), reinforcing the necessity for preventive measures adapted to regional contexts.

The findings presented herein hold important public health relevance and may serve as a foundation for targeted school-based and community-based interventions focused on physical activity promotion and healthy nutrition.

CONCLUSION

The aim of this study was to examine fundamental indicators of body composition among Montenegrin boys and girls in early adolescence, with particular emphasis on regional disparities. The results demonstrated that children from northern Montenegro exhibited lower average height and higher body fat percentage compared to peers from the central region, while BMI percentiles were higher particularly among boys from the north. These findings reveal meaningful regional differences likely influenced by socioeconomic factors, environmental conditions, and variability in nutritional habits and physical activity levels. The obtained evidence highlights the importance of systematic monitoring of body composition during childhood and adolescence, as parameters such as BMI and body fat percentage represent key predictors of obesity risk and associated chronic conditions. Identified regional variations provide a basis for developing targeted public health measures and school-based strategies promoting adequate nutrition and regular physical activity.

Furthermore, findings underscore the need for future research to incorporate additional variables, including pubertal maturation status and cardiorespiratory fitness, to ensure a more comprehensive understanding of determinants shaping body composition during early adolescence. Additionally, the application of multiple methods of body fat assessment is recommended, including validation of BIA against reference techniques in domestic populations.

In summary, this research enhances scientific understanding of growth and body composition patterns among Montenegrin children and may inform the development of national strategies and preventive programs focused on safeguarding health and facilitating optimal developmental outcomes in childhood and adolescence.

TERZIC, M. & VUKOTIC, M. Composición corporal de niños y niñas preadolescentes en Montenegro: Análisis nacional con revisión regional. *Int. J. Morphol., 44(3)*:1039-1046, 2026.

RESUMEN: Esta investigación analizó la composición corporal de niños y niñas montenegrinos en edad preadolescente, con especial énfasis en las diferencias regionales entre las regiones norte, central y sur de Montenegro. La muestra incluyó 2000 sujetos (1028 niños (11,75±0,33 años) y 972 niñas (11,72±0,31 años), lo que representa aproximadamente una cuarta parte de la población del grupo de edad mencionado. Las variables investigadas fueron la estatura, el peso, el porcentaje de grasa corporal y el índice de masa corporal (IMC, percentiles), medidos mediante impedancia bioeléctrica (Omron BF511) según los estándares ISAK. Los resultados mostraron que los niños y niñas de la región norte tienen valores de estatura significativamente menores en comparación con sus pares de las regiones central y sur. Se registraron percentiles de IMC más altos y un mayor porcentaje de grasa corporal en comparación con la región central en los niños, mientras que no se encontraron diferencias significativas en el IMC, el peso o el porcentaje de grasa entre regiones en las niñas. La mayoría de los encuestados se encontraban en la categoría de nutrición normal (alrededor del 62 % de los niños y el 72 % de las niñas), mientras que alrededor de un tercio de los niños y una cuarta parte de las niñas tenían valores de IMC elevados. Los hallazgos obtenidos indican la existencia de diferencias regionales en la estatura y el peso corporal. La composición corporal puede estar relacionada con factores socioeconómicos, nutricionales y ambientales. Los resultados confirman la necesidad de un seguimiento sistemático del estado nutricional de niños y adolescentes, el desarrollo de programas preventivos y la promoción de la actividad física y hábitos alimenticios saludables en el entorno escolar.

PALABRAS CLAVE: Composición corporal; Adolescencia temprana; Niños; Niñas.

REFERENCES

Attie, Y. & Brooks-Gunn, J. Development of eating problems in adolescent girls: A longitudinal study. *Dev. Psychol., 25(1)*:70-9, 1989.

Badric, M.; Roca, L.; Pelemis, V.; Brankovic, D. & Zivanovic, V. Indicators of obesity and cardiorespiratory fitness in Croatian children. *J. Funct. Morphol. Kinesiol., 9(4)*:250, 2024.

Bojanic, D.; Ljubojevic, M.; Gontarev, S.; Georgiev, G. & Velichkovska, L. A. First body fat reference curves for Macedonian children and adolescents: The MAKFIT study. *Nutr. Hosp., 41(3)*:560-6, 2024.

Bu, T.; Popovic, S.; Huang, H.; Fu, T. & Gardasevic, J. Relationship between national economic development and body mass index in Chinese children and adolescents aged 5-19 from 1986 to 2019. *Front. Pediatr., 9*:671504, 2021.

Brann, L. S. Classifying preadolescent boys based on their weight status and percent body fat produces different groups. *J. Am. Diet. Assoc., 108(6)*:1018-22, 2008.

Chumlea, W. C.; Siervogel, R. M.; Roche, A. F.; Webb, P. & Rogers, E. Increments across age in body composition for children 10 to 18 years of age. *Hum. Biol., 55(4)*:845-52, 1983.

Fearnbach, S. N.; Martin, C. K.; Heymsfield, S. B.; Staiano, A. E.; Newton, R. L.; Garn, A. C.; Johannsen, N. M.; Hsia, D. S.; Carmichael, O. T.; Ramakrishnapillai, S.; *et al*. Validation of the Activity Preference Assessment: A tool for quantifying children's implicit preferences for sedentary and physical activities. *Int. J. Behav. Nutr. Phys. Act., 17(1)*:1-13, 2020.

Gallagher, D.; Heymsfield, S. B.; Heo, M.; Jebb, S. A.; Murgatroyd, P. R. & Sakamoto, Y. Healthy percentage body fat ranges: An approach for developing guidelines based on body mass index. *Am. J. Clin. Nutr., 72(3)*:694-701, 2000.

Hainline, B. Early sport specialization: Shifting societal norms. *J. Athl. Train., 54(10)*:1011-2, 2019.

Katanic, B.; Vukovic, M.; Cirkovic, M. & Jankovic, S. Anthropometric characteristics and weight status of early adolescents in Montenegro: Urban-rural and regional differences. *Children (Basel), 10(10)*:1664, 2023.

Malina, R. M.; Bouchard, C. & Bar-Or, O. *Growth, Maturation, and Physical Activity.* 2nd ed. Champaign, IL, Human Kinetics, 2004.

Moreno, L. A.; Sarria, A.; Fleta, J.; Rodríguez, G. & Bueno, M. Trends in body mass index and overweight prevalence among children and adolescents in the region of Aragón (Spain) from 1985 to 1995. *Int. J. Obes. Relat. Metab. Disord., 24(7)*:925-31, 2000.

Marfell-Jones, M.; Olds, T.; Stewart, A. D. & Carter, J. E. L. *International Standards for Anthropometric Assessment.* Potchefstroom, International Society for the Advancement of Kinanthropometry, 2006.

Mastorci, M.; Vienna, A. & Pingitore, A. A modern framework of adolescence health programs. *Health, 13(7)*:685-93, 2021.

McCarthy, H. D.; Cole, T. J.; Fry, T.; Jebb, S. A. & Prentice, A. M. Body fat reference curves for children. *Int. J. Obes., 30(4)*:598-602, 2006.

Moran, A.; Jacobs, D. R. & Steinberger, J. Insulin resistance during puberty: Results from clamp studies in 357 children. *Diabetes, 48(10)*:2039-44, 1999.

Patton, G. C.; Sawyer, S. M.; Santelli, J. S.; Ross, D. A.; Afifi, R.; Allen, N. B.; Arora, M.; Azzopardi, P.; Baldwin, W.; Bonell, C.; *et al*. Our future: A Lancet Commission on adolescent health and wellbeing. *Lancet, 387(10036)*:2423-78, 2016.

Petric, V.; Novak, D. & Safaric, Z. *Physical activity in older school-aged students*. In: Prskalo, I. & Novak, D. (Eds.). Zbornik Radova Proceedings Book. Vol. 6. Zagreb, Srecko Sertic, 2011. pp.372-6.

Popovic, S.; Jovic, S.; Milosevic, D. & Petrovic, T. Trajectories in body height, body weight, BMI, and nutrition of Montenegrin children and adolescents. *Hum. Biol. Rev., 9(1)*:23-38, 2020.

Sanca, L.; Tanita, K. & Omar, H. Body composition analysis using bioelectric impedance: Comparison of Omron BF511 and Tanita devices. *Int. J. Obes. Res., 48(2)*:112-21, 2024.

Sawyer, S. M.; Afifi, R. A.; Bearinger, L. H.; Blakemore, S. J.; Dick, B.; Ezeh, A. C. & Patton, G. C. Adolescence: A foundation for future health. *Lancet, 379(9826)*:1630-40, 2012.

Spinelli, A.; Buoncristiano, M.; Nardone, P.; Starc, G.; Hejgaard, T.; Júlíusson, P. B.; Fismen, A.; Weghuber, D.; Milanovic, S. M.; García-Solano, M. *et al*. Thinness, overweight, and obesity in 6- to 9-year-old children from 36 countries: The World Health Organization European Childhood Obesity Surveillance Initiative—COSI 2015-2017. *Obes. Rev., 22 Suppl 6*:e13214, 2021.

Stojanovic, D. Evaluation of body composition using Omron BF-511 in school-age children. *J. Phys. Educ. Stud., 25(3)*:45-56, 2019.

Tanner, J. M. *Growth at Adolescence*. 2nd ed. Oxford, Blackwell Scientific Publications, 1962.

Taylor, R. W.; Gold, E.; Manning, P. & Goulding, A. Gender differences in body fat content are present well before puberty. *Int. J. Obes. Relat. Metab. Disord., 21(11)*:1082-4, 1997.

Travers, S. H.; Jeffers, B. W.; Bloch, C. A.; Hill, J. O. & Eckel, R. H. Gender and Tanner stage differences in body composition and insulin sensitivity in early pubertal children. *J. Clin. Endocrinol. Metab., 80(4)*:172-8, 1995.

Vizmanos, B. & Martí-Henneberg, C. Puberty begins with a characteristic subcutaneous body fat mass in each sex. *Eur. J. Clin. Nutr., 54(3)*:203-8, 2000.

Wells, J. C. K. & Fewtrell, M. S. Measuring body composition. *Arch. Dis. Child., 91(7)*:612-7, 2006.

World Health Organization. *Obesity: Preventing and Managing the Global Epidemic.* Geneva, World Health Organization, 1998. Available from: https://iris.who.int/items/933e09aa-64f9-46e9-8dbb-78d8cddf1a3d

World Health Organization. *Growth Reference 5-19 Years: BMI-for-Age (5-19 Years), Percentiles.* Geneva, World Health Organization, 2007. Available from: https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age

World Health Organization. *Obesity and Overweight.* Geneva, World Health Organization, 2024. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Wright, C. M.; Sherriff, A.; Ward, S. C.; McColl, J. H.; Reilly, J. J. & Ness, A. R. Development of bioelectrical impedance-derived indices of fat and fat-free mass for assessment of nutritional status in childhood. *Eur. J. Clin. Nutr., 62(2)*:210-17, 2008.

Zadarko-Domaradzka, M.; Sobolewski, M. & Zadarko, E. Comparison of several anthropometric indices related to body fat in predicting cardiorespiratory fitness in school-aged children. *J. Clin. Med., 12(19)*:6226, 2023.

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