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Association of Weight Status with Geographic Region, Residential Status and Sex of 8th Grade School Children: The Prevalence of Overweight and Obesity in Montenegro

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Abstract

The aim of the research was to determine the association between weight status with residential status, geographic region, and sex in younger adolescent age group in Montenegro. The sample was stratified based on gender, settlement type, and geographic region in Montenegro. Anthropometric characteristics were assessed using a battery of three variables: body height (BH), body weight (BW), and body mass index (BMI). BMI was categorized based on the World Health Organisation's (WHO) cut-offs to underweight, normal weight, overweight and obese individuals. The sample comprised 534 early adolescents, specifically 8th grade students, including 283 boys (average age 13.52±0.42 years) and 251 girls (average age 13.51±0.40 years) from primary schools throughout Montenegro. Based on the Chi-square test, an association between weight status and geographic region was found among boys and in the overall sample of children, with the highest prevalence of obesity in the northern region. There is also a significant association between weight status and residential status of adolescents, with obesity being more prevalent among rural children compared to urban children. Additionally, an association between sex and weight status was established, with obesity being more prevalent in boys compared to girls. Therefore, these findings highlight the need for targeted intervention and the promotion of healthy lifestyles among children, taking these demographic factors into account.

Keywords: *anthropometric characteristics, BMI status, nutritional status, prevalence of obesity, adolescents*

Introduction

The substantial changes in people's lifestyles have an impact on children's and adolescents' physical growth as well (Ferreira et al., 2007). The period between the ages of 10 and 19 is termed as adolescence and is characterized by rapid and crucial phases of human development affecting a person's physical, emotional, cognitive, and social development, among other aspects (WHO, 2017). Insufficient physical activity and unhealthy dietary practices are leading to a widespread increase in overweight and obesity, reaching epidemic levels particularly in developed nations (Wijnhoven et al., 2014).

One of the biggest health issues we face today is obesity, which has a number of associated changes that reduce life expectancy (Stankovic et al., 2021). In most economically developed nations as well as some low-income nations, the prevalence of pediatric obesity has doubled or tripled over the past three decades, mostly in metropolitan areas (Wang & Lobstein, 2006). Additionally, obesity has social and psychological repercussions: it is associated with negative feelings of worth, lack of confidence, and sadness (Storch et al., 2007).

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Children are important members of our society, and it has been recognized that monitoring their growth is essential to identifying population health patterns and formulating successful strategies (Sofi & Senthilvelan, 2021). There appears to be a north-south gradient in obesity incidence in Europe, with southern European nations showing the highest frequency (Wijnhoven et al., 2014). The balance between energy intake and expenditure may be affected by previous social and economic changes in Montenegro toward a Western lifestyle and more democratic markets (Telbisz et al., 2014). Despite having limited usefulness in assessing body fat in children and adolescents body mass index is still a practical technique to identify overweight and obesity (Woźniacka et al., 2018). Additionally, the comparison of results between nations is made possible by the availability of data on BMI assessed in sizable population groupings (Must & Anderson, 2006; Reilly, 2006).

In recent decades, there has been a sharp rise in the frequency of overweight and obesity among children and adolescents from Slovenia (Kovač et al., 2014), Poland (Woźniacka et al., 2018), Hungary (Antal et al., 2009), North Macedonia (Morina, Miftari, Georgiev, & Gontarev, 2022), Albania (Jarani, Spahi, Vrenjo, & Ushtelenca, 2022) and Kosovo (Tishukaj et al., 2017). Also, this trend was recorded in Montenegro for children from 6-9 years old (Vasiljevic & Petkovic, 2023), likewise for adolescent (Martinovic et al., 2015; Katanic et al. 2023b). The fact that every third child in Montenegro between the ages of 9 and 13 is overweight or obese (Milasinovic et al., 2019) raises serious concerns among researches. In addition, according to a study in which Hungarian schoolchildren took part, 48% of boys and 28% of girls identified as overweight by BMI were actually obese based on their body fat percentage (Antal et al., 2009). Tishukaj et al. (2017) conducted a study to investigate the physical fitness and anthropometric characteristics of adolescents residing in various regions of Kosovo. The mentioned research highlighted a notable prevalence of overweight and obesity, particularly among boys aged 14 to 15.

Based on the aforementioned information, while numerous studies have focused on the prevalence of overweight and obesity, according to the author's knowledge there are no studies that specifically explore the association between these variables and geographical regions. Therefore, the aim of the research was to determine the association between weight status and residential status, as well as the association between the weight status and the geographic region of boys and girls in the younger adolescent age group in Montenegro. This study will provide a substantial and crucial dataset concerning the weight status and living arrangements of adolescents in the younger age group, specifically within a defined European region.

Methods

Participants

The sample included early adolescents, specifically 8th-grade students, from primary schools throughout Montenegro. A total of 534 students took part in this cross-sectional study (283 boys, with an average age of 13.52±0.42 years, and 251 girls, with an average age of 13.51±0.40 years). The sample was stratified by gender, geographic region, and type of settlement. Montenegro's geographic division comprises northern, central, and coastal regions. Settlement types are categorized according to administrative criteria and population size. Rural areas consist of villages and small towns with populations of 10,000 or fewer, while urban areas include locations with populations exceeding 10,000 (Monstat, 2011). Table 1 provides a detailed breakdown of the sample characteristics. Participation in the study was voluntary, with parental consent, and the research adhered to the principles outlined in the Helsinki Declaration.

Table 1. Characteristics of sample population

Gender	(number, %)
Boys	283 (53.00%)
Girls	251 (47.00%)
Geographical region	(number, %)
Northern	73 (13.67%)
Central	382 (71.54%)
Coastal	79 (14.79%)
Type of settlement	(number, %)
Urban	380 (71.16%)
Rural	154 (28.84%)

Measurements

A standardized international biological method was employed to evaluate morphological traits. Anthropometric measurements were taken using three key variables: body height (BH), body weight (BW), and body mass index (BMI). Height was measured with a portable stadiometer (Seca Ltd., Bonn, Germany), accurate to 0.1 cm. Body weight was recorded using a Tanita body fat scale (Tanita ® model BC-418MA, Tokyo, Japan). The body mass index (BMI) was calculated using the formula: $BMI=BW(kg)/BH(m)^2$. Based on the World Health Organization (WHO) criteria, BMI was categorized into underweight, normal weight, overweight, and obese groups (Onis et al., 2007).

Statistics

The basic descriptive statistics parameters were calculated, including the arithmetic mean, standard deviation, minimum, maximum, and percentages. To examine the relationship between weight status and residential status, the Chi-square (χ^2) test was applied, as well as the association between weight status and residential region, for boys and girls in the younger adolescent age group. For all statistical analyses, a significance level of $p<0.05$ was considered. Data were processed using the Statistical Package for Social Sciences (SPSS), version 26.0 (SPSS Inc., Chicago, IL, USA), along with Microsoft Excel (version 13, Microsoft Corporation, Redmond, WA, USA).

Results

According to Table 1, the total number of participants was 534, with 53% being boys. The largest share of participants comes from the central region, accounting for 71.54%. Additionally, the ratio of urban to rural participants is 71.16% to 28.84%.

For boys, the average age was 13.52±0.42 years, with an average body height of 169.43±8.89 cm, body weight of 60.54±13.47 kg, and a BMI of 20.99±3.78. While for girls, the average age was 13.51±0.40 years, with an average body height of 165.54±6.67 cm, body weight of 55.28±9.27 kg, and a BMI of 20.13±2.99.

Table 2. Descriptive statistics

		Mean	Std. Dev.	Min	Max
Body Height (cm)	Boys	169.43	8.89	145.0	190.0
	Girls	165.54	6.67	151.0	187.0
	Total	167.60	8.15	145.0	190.0
Body Mass (kg)	Boys	60.54	13.47	34.6	110.2
	Girls	55.28	9.27	33.0	82.8
	Total	58.07	11.97	33.0	110.2
BMI	Boys	20.99	3.78	13.63	34.49
	Girls	20.13	2.99	13.91	32.49
	Total	20.58	3.45	13.63	34.49

Association between the weight status and the geographic region

Table 3 presents the distribution of weight status (Underweight, Normal, Overweight, Obese) among three different geographic regions (Northern, Central, Coastal) based on the boys' places of residence. Based on the Chi-square test ($\chi 2$) determined a significant association between the weight status and geographic regions ($\chi 2=22.11$, $p=0.001$). The coefficient φ (phi) value of 0.280 signifies a moderate to strong association between these two variables. The highest percentage of obese boys is in the North, with 23.3%, while the Central and Coastal regions have 10% obese boys each. When considering overweight as well, the highest percentage is in the Coastal region at 50%, followed by the North at 39.5%, and the Central zone with 24% of boys classified as overweight.

In this table (Table 3), the results of the Chi-square test indicate that there is no significant association between weight status and geographical region of girls.

Table 3 also illustrates the distribution of weight status based on the geographic region of total children. The results of the Chi-square test indicate significant association between the weight status and geographic regions ($\chi 2=28.19$, $p=0.000$) of children. The coefficient φ (phi) value of 0.230 suggests a moderate association between these two variables. There is a notably high percentage of overweight and obese children combine, totaling nearly 50%, in the central and northern parts, while in the southern part, this percentage is much lower.

Table 3. The association between the weight status and the geographic region of children

Boys	Underweight	Normal	Overweight	Obese
Northern	0.0%	37.2%	39.5%	23.3%
Central	3.5%	61.9%	24.3%	10.4%
Coastal	0.0%	39.5%	50.0%	10.5%
		$\chi 2(6, n\text{-}283)=22.11$, $p=0.001$, $\varphi=0.280$		
Girls	Underweight	Normal	Overweight	Obese
Northern	0.0%	66.7%	23.3%	10.0%
Central	1.7%	78.3%	17.8%	2.2%
Coastal	0.0%	65.9%	26.8%	7.3%
		$\chi 2(6, n\text{-}251)=9.03$, $p=0.172$, $\varphi=0.190$		
Total children	Underweight	Normal	Overweight	Obese
Northern	0.0%	49.3%	32.9%	17.8%
Central	2.6%	69.6%	21.2%	6.5%
Coastal	0.0%	53.2%	38.0%	8.9%
		$\chi 2(6, n\text{-}534)=28.19$, $p=0.000$, $\varphi=0.230$		

Legend: $\chi 2$ - Coefficient of the Chi square test; p - Coefficient of significance, φ - measure of association.

Association between the weight status and the residential status

Based on the Chi-square test (Table 4), an association between weight status and residential status in boys was determined ($\chi 2=14.22$, $p=0.003$). The coefficient φ (phi) value of 0.224 suggests a moderate association between these two variables. There is a tendency for rural areas to have a higher percentage of overweight and obese boys combined compared to boys from urban areas.

An association between weight status and residential status in girls was determined ($\chi2=13.17$, $p=0.004$; Table 4). The coefficient φ (phi) value of 0.229 suggests a moderate association between these two variables. Additionally, girls from rural areas have a higher percentage of combined overweight and obesity compared to girls from urban areas.

The association between weight status and the residential status of children was also found in the total sample of children ($\chi2=24.10$, $p=0.000$; Table 4). The coefficient φ (phi) value of 0.229 suggests a moderate association between these two variables. The table shows that nearly every second child from rural areas is overweight or obese, while this percentage is much lower for urban children, around 28%.

Association between the weight status and the sex

When it comes to the association between the sex and weight status of participants, a significant association has been established ($\chi2=25.71$, $p=0.000$; Table 5). The coefficient φ (phi) value of 0.219 suggests a moderate association between these two variables. The table indicates a higher frequency of obesity in boys compared to girls.

Table 4. The association between the weight status and the residential status of children.

Boys	**Underweight**	**Normal**	**Overweight**	**Obese**
Urban	3.0%	61.2%	23.9%	11.9%
Rural	1.2%	40.2%	45.1%	13.4%
		$\chi2(3, n\text{-}283)=14.22$, $p=0.003$, $\varphi=0.224$		
Girls	Underweight	Normal	Overweight	Obese
Urban	0.6%	81.0%	15.1%	3.4%
Rural	2.8%	59.7%	31.9%	5.6%
		$\chi2(3, n\text{-}251)=13.17$, $p=0.004$, $\varphi=0.229$		
Total children	Underweight	Normal	Overweight	Obese
Urban	1.8%	70.5%	19.7%	7.9%
Rural	1.9%	49.4%	39.0%	9.7%
		$\chi2(3, n\text{-}534)=24.10$, $p=0.000$, $\varphi=0.212$		

Legend: χ2 - Coefficient of the Chi square test; p - Coefficient of significance, φ - measure of association.

Table 5. The association between the sex and the the weight status.

	Underweight	**Normal**	**Overweight**	**Obese**
Boys	2.5%	55.1%	30.0%	12.4%
Girls	1.2%	74.9%	19.9%	4.0%
		$\chi2(3, n\text{-}534)=25.71$, $p=0.000$, $\varphi=0.219$		

Legend: χ2 - Coefficient of the Chi square test; p - Coefficient of significance, φ - measure of association.

Discussion

The aim of the study was to determine the relationship between weight status and residential status, geographic regions and sex of children in the younger adolescent age group in Montenegro. The main findings are: i) a significant association between weight status and geographic region was found in boys and in the total sample of children, while this association was absent in the group of girls; the prevalence of obesity is most pronounced in the northern region; ii) a significant association between weight status and residential status was found in both boys and girls groups, as well as in the total sample of children; the prevalence of obesity is more pronounced in rural compared to urban children; iii) a significant association between sex and weight status has been established; higher frequency of obesity was found in boys compared to girls.

Being overweight in adolescent years is a common thing nowadays. Most of this population aren't immune to this disease and if certain actions aren't made in proper time, it can be continued in the adulthood (Kohn & Golden, 2001; Mitić, 2011). Based on the fact that current study have revealed a significant association between weigh status and geographic region, where the obesity prevalence is pronounced in the north of the Montenegro, this result could partially be in the line with study conducted by Gallotta et al. (2022). Although they have revealed that geographic region is influential on the weight status, a higher BMI proportion was also revealed in the center of the Italy, compared to the north and south. In addition, we have also identified a more pronounced obesity prevalence in rural compared to urban children, which is consistent with previously published European studies (Gallotta et al., 2022; Novak et al., 2015), as well as significant association between weight and residential status, which is further confirmed by Katanic et al. (2023a). Since Montenegro is predominantly smaller country, we should take into consideration the fact that bigger and more populated cities are coastally located, while the north of the country have smaller countries with less population, considering that the northern and central parts of the country are dominated by forests. According to the statistical office of Montenegro, 57.64% of the country is covered with forest and 10.02% is forest land (Monstat, 2021) which is mostly spacious in the central and north of the country. Moreover, the population density in central and north part are less pronounced (ranging from 4-9 and 10-37 inhabitans per km2), in regard to coastal (38-78, 79-158 and 159-305 inhabitans per km2) (Monstat, 2023). Although there are studies who have identified that rural area children have lower values of BMI (Chillon et al., 2011; Vasić et al., 2012), which is contrary to our result, the main explaination may lie in the accessibility of physical activities in urban vs rural regions (Davy et al., 2004).

Consequently, different levels of urbanization and density population leads to varying access to sports facilities and opportunity to perform sports (Parks et al., 2003; Reimers et al., 2014), i.e. according to Ilic et al. (2023), adolescents from the urban areas are significantly more involved in sports than those from the rural areas. In addition, current education level of adolescents themselve, but also parental education status and family income status (Andrade et al., 2014) should not be ignored as influential factors on the weight status. Following that, it is most likely that those children will become low-educated themselves, which will accumulate health risks in the area of health behaviour (Viner et al., 2012). Hence, the surroundings in which adolescents live and attend school as well, might influence their healthy habits and contribute to obesity level changes (Levy et al., 2011).

It is a little bit paradox that physical activity level is higher in boys than in girls, but their physical fitness level is the opposite (Strel et al., 2007). In that regard, it is a notable general incosistency among boys and girls weight status as defined by BMI (Kovač et al., 2014; Ogden et al., 2012; Stamatakis et al., 2005; Vuorela et al., 2011; Whelton et al., 2007; Yuca et al., 2010). What's more, there are some recent findings who have emphasizing that boys have higher prevalence of overweight and obesity (Shehzad et al., 2022; Vrevic, 2023), which is in a line with our obtained results. But if we draw a line here, the diverse results may be explained due to biology, culture, or their combination, as well as the genetic conditioning (Banjevic et al., 2022). Although BMI may also vary with age, gender or maturity status (Yoon et al., 2024), there are few things that must be taken into consideration. Weight status could be related to adequate diet and even eating habits, especially while spending time in school (Adams et al., 2014). Likewise, choosing unhealthy habits, such as avoiding physical activities, jung food consumation, being sedentary during leisure time, playing video games, staying up late and sleeping irregularly, can disturb the regular processes of growth and potentially cause health complications (Li et al., 2017; Olson et al., 2019; Zsakai & Bodzsar, 2014). Consequently, it is necessary to reconsider physical activitiy level in physical education classes, as well as a greater emphasis on more frequent weight status evaluations and their external factors influences. In addition, transport to school must not be neglacted. To date, there is little data on the transportation of children and adolescents to places, especially to school. Therefore, future studies should include the mentioned parameters, which would help in gaining a deeper understanding of the factors contributing to childhood obesity.

Therefore, although this study showed that the prevalence of obesity is higher among children from less developed areas, it is clear that numerous potential factors are behind these results. On one hand, additional research is needed to identify specific causes. On the other hand, these findings indicate the need for the involvement of leading sports institutions in Montenegro to promote sports and healthy lifestyles among children from rural areas. This includes organizing sports programs, improving infrastructure for physical activities, and implementing educational programs on nutrition and health, among other initiatives. Only through a comprehensive approach can we expect significant changes in the prevention and reduction of obesity among children in Montenegro.

The strength of the study lies in the fact that this is one of the rare studies that has established an association between weight status with regional and urban-rural status of adolescents. Additionally, it should be emphasized that the study included a large sample of adolescents of both genders from different parts of the country. This allows for relevant and general conclusions to be drawn about the weight status of younger adolescents in Montenegro, as well as the connection between weight status and the regional and urban-rural status of the respondents.

Some of the limitations of the study are reflected in the absence of skinfold and body composition parameters, which would provide a more complete picture of the adolescents' body composition (Đorđević et al., 2024). Future studies could include these parameters, but they could also examine the level of physical activity, dietary habits, and transportation habits of the respondents, which might indicate the reasons for the observed differences in weight status. In this way, a more comprehensive picture of the factors affecting the weight status of younger adolescents in Montenegro would be provided.

Conclusion

This study has shown a significant association between weight status and geographic region, with the highest prevalence of obesity in the northern region. Also, an association between residential status and obesity was found, with children from rural areas being more prone to obesity compared to children from urban areas. Therefore, these findings highlight the need for targeted intervention and the promotion of healthy lifestyles among children, taking these demographic factors into account.

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Conflicts of interest
The authors declare that there are no conflict of interest.

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References

Adams, K. F., Leitzmann, M. F., Ballard-Barbash, R., Albanes, D., Harris, T. B., & Hollenbeck, A. (2014). Respond to "Body Mass Index and Mortality." *American Journal of Epidemiology*, *179*(2), 147–148.

Andrade N., F., Eto, F. N., Pereira, T. S. S., Carletti, L., & Molina, M. del C. B. (2014). Active and sedentary behaviours in children aged 7 to 10 years old: the urban and rural contexts, Brazil. *BMC Public Health*, *14*, 1–10.

Antal, M., Péter, S., Biró, L., Nagy, K., Regöly-Mérei, A., Arató, G., Szabó, C., & Martos, É. (2009). Prevalence of underweight, overweight and obesity on the basis of body mass index and body fat percentage in Hungarian schoolchildren: representative survey in metropolitan elementary schools. *Annals of Nutrition and Metabolism*, *54*(3), 171–176.

Banjevic, B., Zarkovic, B., Katanic, B., Jabucanin, B., Popovic, S., & Masanovic, B. (2022). Morphological Characteristics and Situational Precision of U15 and U16 Elite Male Players from Al-Ahli Handball Club (Bahrein). *Sports*, *10*(7), 108.

Chillon, P., Ortega, F. B., Ferrando, J. A., & Casajus, J. A. (2011). Physical fitness in rural and urban children and adolescents from Spain. *Journal of Science and Medicine in Sport*, *14*(5), 417–423.

Davy, B. M., Harrell, K., Stewart, J., & King, D. S. (2004). Body weight status, dietary habits, and physical activity levels of middle school-aged children in rural Mississippi. *Southern Medical Journal*, *97*(6), 571–578.

Đorđević, S., Hadzovic, M., Lilic, A., Jorgić, B., Jelenković, L., Stojiljković, N., Katanic, B., & Stankovic, M. (2024). Effects of Non-Compliance with the Protocol on InBody 770 in Students of Different Training. Sport Mont, 22(1), 23-29. https://doi.org/10.26773/smj.240204

Ferreira, I., Van Der Horst, K., Wendel-Vos, W., Kremers, S., Van Lenthe, F. J., & Brug, J. (2007). Environmental correlates of physical activity in youth–a review and update. *Obesity Reviews*, *8*(2), 129–154. https://doi.org/10.1111/j.1467-789X.2006.00264.x

Gallotta, M. C., Zimatore, G., Falcioni, L., Migliaccio, S., Lanza, M., Schena, F., Biino, V., Giuriato, M., Bellafiore, M., & Palma, A. (2022). Influence of geographical area and living setting on children's weight status, motor coordination, and physical activity. *Frontiers in Pediatrics*, *9*, 794284.

Ilic, P., Vitasovic, M., Katanic, B., Rakocevic, R., & Vasileva, F. (2023). Impact

of residential status on sports activity, anthropometric characteristics and motor abilities of adolescents. *Journal of Anthropology of Sport and Physical Education*, *7*(2), 19–23.

Jarani, J., Spahi, A., Vrenjo, K., & Ushtelenca, K. (2022). Comparison of Body Weight between Albanian Children and European Peers in Primary Schools. *Sport Mont, 20*(1), 39-43. https://doi.org/10.26773/smj.220207

Katanic, B., Bjelica, D., Stankovic, M., Milosevic, Z., Vukovic, J., & Mekic, A. (2023a). Anthropometric Characteristics and Weight Status of Early Adolescents (Aged 12–14) in Montenegro; Urban–Rural and Regional Differences. *Children*, *10*(10), 1664.

Katanic, B., Prvulovic, N., Preljevic, A., Osmani, A., Corluka, M., & Bjelica, D. (2023b). Morphological Characteristics and Body Mass Status of School Girls according to Different Regional Zones. *Sport Mont, 21*(1), 61-64. https://doi.org/10.26773/smj.230210

Kohn, M., & Golden, N. H. (2001). Eating disorders in children and adolescents: epidemiology, diagnosis and treatment. *Paediatric Drugs*, *3*, 91–99.

Kovač, M., Jurak, G., Kragelj, L. Z., & Leskošek, B. (2014). The secular trend in the prevalence of overweight and obesity in the population of primary school children from Ljubljana (Slovenia). *Slovenian Journal of Public Health*, *53*(2), 188–198.

Levy, D. T., Mabry, P. L., Wang, Y. C., Gortmaker, S., Huang, T., Marsh, T., Moodie, M., & Swinburn, B. (2011). Simulation models of obesity: a review of the literature and implications for research and policy. *Obesity Reviews*, *12*(5), 378–394.

Li, X., Kearney, P. M., Keane, E., Harrington, J. M., & Fitzgerald, A. P. (2017). Levels and sociodemographic correlates of accelerometer-based physical activity in Irish children: a cross-sectional study. *The Journal of Epidemiology and Community Health 71*(6), 521–527.

Martinovic, M., Belojevic, G., Evans, G. W., Lausevic, D., Asanin, B., Samardzic, M., ... & Boljevic, J. (2015). Prevalence of and contributing factors for overweight and obesity among Montenegrin schoolchildren. *The European Journal of Public Health*, *25*(5), 833–839.

Milasinovic, R., Bojanic, D., Cvorovic, A., & Kukic, F. (2019). Age and Gender Differences in Nutritional Status of School Children According to WHO, CDC and IOTF References: A Statewide Study from Montenegro. *Sport Mont*, *17*(1), 15–21.

Mitić, D. (2011). Značaj fizičke aktivnosti u prevenciji i terapiji gojaznosti u detinjstvu i adolescenciji [The importance of physical activity in the prevention and treatment of obesity in childhood and adolescence]. *Medicinski Glasnik Specijalne Bolnice Za Bolesti Štitaste Žlezde i Bolesti Metabolizma'Zlatibor'*, *16*(39), 107–112.

Monstat. (2011). *Population of Montenegro by Gender, Type of Settlement, National or Ethnic Affiliation, Religion and Mother Tongue by Municipalities in Montenegro*. Statistical Office of Montenegro. http://monstat.org/eng/page.php?id=259&pageid=259

Monstat. (2021). *Statistical yearbook 2021*. Podgorica: Statistical Office of Montenegro. https://monstat.org/uploads/files/publikacije/godisnjak 2021/STATISTIČKI GODISNJAK 2021.pdf

Monstat. (2023). *Montenegro in numbers 2023*. Podgorica: Statistical Office of Montenegro. https://www.monstat.org/uploads/files/publikacije/CG u brojkama 2023.pdf.

Morina, B., Miftari, F., Georgiev, G., & Gontarev, S. (2022). Total and Abdominal Adiposity are Lower in Overweight and Obese Children with High Cardiorespiratory Fitness. *Sport Mont, 20*(1), 103-107.

Must, A., & Anderson, S. E. (2006). Body mass index in children and adolescents: considerations for population-based applications. *International Journal of Obesity*, *30*(4), 590–594.

Novak, D., Bernstein, E. R., Podnar, H., & Vozzolo, Y. (2015). Differences in the fitness levels of urban and rural middle school students in Croatia. *Physical Educator*, *72*(4), 553–576.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Jama*, *307*(5), 483–490.

Olson, J. L., March, S., Brownlow, C., Biddle, S. J. H., & Ireland, M. (2019). Inactive lifestyles in peri-urban Australia: A qualitative examination of social and physical environmental determinants. *Health Promotion Journal of Australia*, *30*(2), 153–162.

Onis, M. de, Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization*, *85*(9), 660–667.

Parks, S. E., Housemann, R. A., & Brownson, R. C. (2003). Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *Journal of Epidemiology & Community Health*, *57*(1), 29–35.

Reilly, J. J. (2006). Diagnostic accuracy of the BMI for age in paediatrics. *International Journal of Obesity*, *30*(4), 595–597.

Reimers, A. K., Wagner, M., Alvanides, S., Steinmayr, A., Reiner, M., Schmidt, S., & Woll, A. (2014). Proximity to sports facilities and sports participation for adolescents in Germany. *PLoS One*, *9*(3), e93059.

Shehzad, M. A., Khurram, H., Iqbal, Z., Parveen, M., & Shabbir, M. N. (2022). Nutritional status and growth centiles using anthropometric measures of school-aged children and adolescents from Multan district. *Archives de Pédiatrie*, *29*(2), 133–139.

Sofi, M. A., & Senthilvelan, S. (2021). Study Of Anthropometric Measurements Among Rural And Urban Area School Boys Of Kashmir Region. *Turkish Online Journal of Qualitative Inquiry*, *12*(7), 12719–12732.

Stamatakis, E., Primatesta, P., Chinn, S., Rona, R., & Falascheti, E. (2005). Overweight and obesity trends from 1974 to 2003 in English children: what is the role of socioeconomic factors? *Archives of Disease in Childhood*, *90*(10), 999–1004.

Stankovic, M., Djodjevic, S., Hadzovic, M., Djordjevic, D., & Katanic, B. (2021). The Effects Of Physical Activity On Obesity Among The Population Of Different Ages: A Systematic Review. *Journal of Anthropology of Sport and Physical Education*, *5*(3), 19–26.

Storch, E. A., Milsom, V. A., DeBraganza, N., Lewin, A. B., Geffken, G. R., & Silverstein, J. H. (2007). Peer victimization, psychosocial adjustment, and physical activity in overweight and at-risk-for-overweight youth. *Journal of Pediatric Psychology*, *32*(1), 80–89.

Strel, J., Kovač, M., & Jurak, G. (2007). Physical and motor development, sport activities and lifestyles of Slovenian children and youth-changes in the last few decades. In W. Brettschneider & R. Naul (Eds.), *Obesity in Europe: young people's physical activity and sedentary lifestyles* (pp. 243–264).

Telbisz, T., Bottlik, Z., Mari, L., & Kőszegi, M. (2014). The impact of topography on social factors, a case study of Montenegro. *Journal of Mountain Science*, *11*, 131–141.

Tishukaj, F., Shalaj, I., Gjaka, M., Ademi, B., Ahmetxhekaj, R., Bachl, N., ... & Wessner, B. (2017). Physical fitness and anthropometric characteristics among adolescents living in urban or rural areas of Kosovo. *BMC Public Health*, *17*(1), 1–15.

Vasić, Z., Vidović, S., Vulić, I., Šnjegota, D., Šuščević, D., Bojić, N., & Baroš, I. (2012). Comparative analysis of anthropometric parameters of the primary school pupils of urban and rural Doboj region. *Glasnik Antropološkog Društva Srbije*, *47*, 163–171.

Vasiljevic, I., & Petkovic, J. (2023). The prevalence of overweight and obesity: a measurement-based analysis of 6–9-year-old school children from Montenegro. *Frontiers in Public Health*, *11*, 1194600.

Viner, R. M., Ozer, E. M., Denny, S., Marmot, M., Resnick, M., Fatusi, A., & Currie, C. (2012). Adolescence and the social determinants of health. *The Lancet*, *379*(9826), 1641–1652.

Vrevic, E. (2023). Differences in obesity status among adolescents living in urban and rural areas of the municipality of Pljevlja. *Journal of Anthropology of Sport and Physical Education*, *7*(3), 9–12.

Vuorela, N., Saha, M., & Salo, M. K. (2011). Change in prevalence of overweight and obesity in Finnish children–comparison between 1974 and 2001. *Acta Paediatrica*, *100*(1), 109–115.

Wang, Y., & Lobstein, T. I. M. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity*, *1*(1), 11–25.

Whelton, H., Harrington, J., Crowley, E., Kelleher, V., Cronin, M., & Perry, I. J. (2007). Prevalence of overweight and obesity on the island of Ireland: results from the North South Survey of Children's Height, Weight and Body Mass Index, 2002. *BMC Public Health*, *7*, 1–9.

Wijnhoven, T. M. A., van Raaij, J. M. A., Spinelli, A., Starc, G., Hassapidou, M., Spiroski, I., ... & Hovengen, R. (2014). WHO European Childhood Obesity Surveillance Initiative: body mass index and level of overweight among 6–9-year-old children from school year 2007/2008 to school year 2009/2010. *BMC Public Health*, *14*, 1–16.

WHO. (2017). *Global Accelerated Action for the Health of Adolescents (AA-HA!): guidance to support country implementation.*

Woźniacka, R., Bac, A., Kowal, M., & Matusik, S. (2018). Differences in the prevalence of overweight and obesity in 5-to 14-year-old children in Kraków, Poland, using three national BMI cut-offs. *Journal of Biosocial Science*, *50*(3), 365–379.

Yoon, C. Y., Arlinghaus, K. R., Ledoux, T. A., Johnston, C. A., Larson, N., & Neumark-Sztainer, D. (2024). Associations of regular consumption of breakfast, lunch, and dinner with BMI during adolescence: Longitudinal findings by weight status among the EAT 2010-2018 cohort. *Public Health Nutrition*, *27*(1), 1–29.

Yuca, S. A., Yılmaz, C., Cesur, Y., Doğan, M., Kaya, A., & Başaranoğlu, M. (2010). Prevalence of overweight and obesity in children and adolescents in eastern Turkey. *Journal of Clinical Research in Pediatric Endocrinology*, *2*(4), 159–163.

Zsakai, A., & Bodzsar, E. B. (2014). The relationship between body structure and the socio-economic status in Hungarian children and adolescents. *Collegium Antropologicum*, *38*(2), 479–485.