SportMont

ORIGINAL SCIENTIFIC PAPER

Morphological Characteristics and Body Mass Status of School Girls according to Different Regional Zones

Borko Katanic[1], Nikola Prvulovic[1], Adem Preljevic[2], Arben Osmani[3], Marin Corluka[4], Dusko Bjelica[5]

[1]University of Nis, Faculty of Sports and Physical Education, Nis, Serbia, [2]State University of Novi Pazar, Novi Pazar, Serbia, [3]AAB College, Pristina, Kosovo, [4]University of Mostar, Faculty of Science and Education, Mostar, Bosnia and Herzegovina, [5]University of Montenegro, Faculty for Sports and Physical Education, Niksic, Montenegro

Abstract

There are many factors that have an influence on obesity therefore, early regular monitoring of morphological characteristics and nutritional status of children is the best prevention method. This study aimed to examine the influence of two regional zones in Montenegro on morphological differences and the nutritional status of school girls. The sample of respondents was selected from several different primary schools. The sample was divided by regions (Vlada Crne Gore, 2011) into two groups, girls from the Central region (n-55, 10.21±.72 years), and the Coastal region (n-42, 10.33±.59 years). Morphological characteristics were assessed using a battery of four variables: body height (BH), body weight (BW), waist circumference (WC), and hip circumference (HC). BMI and waist-to-hip ratio (WHR) values were calculated. We used WHO cutoff points for the assessment of the children's nutrition status. For determining differences between children living in different regions we used a T-test for independent samples. 27.27% of girls from the Central region are obese compared to 23.81% of obese in the Coastal region. When comparing groups by regional regions, it is noticeable that there is no significant difference in morphological characteristics and body mass index. Although there is no difference in the morphological characteristics between girls of the Central and Coastal regions, for more detailed conclusions, a larger number of morphological parameters should be monitored on a larger sample of respondents.

Keywords: *anthropometrics characteristics, body mass index, level of nutrition, school girls, regional zones*

Introduction

Today's children are increasingly inactive, spending as much as half of their waking hours in a sedentary position (Colley et al., 2013). Such a sedentary lifestyle with poor nutrition can lead to obesity in children.

Childhood obesity is a hidden epidemic and is currently one of the major public health problems (Kumar & Kaufman, 2018). Childhood obesity is associated with various health problems such as diabetes, asthma, hypertension, atherosclerosis, and psychosocial disorders (Dikanovic & Vignjevic, 2009). In addition, obese (OB) children have weaker motor skills (Barnett et al., 2016; Banjevic, Aleksic, Aleksic Veljkovic, Katanic, & Masanovic, 2022) and lower levels of physical activity (PA) than healthy-weight (HW) children (Elmesmari, Martin, Reilly, & Paton, 2018). Nowadays, almost one-third (31%) of children in the world have body weight above healthy levels, which is quite alarming (Spiotta & Luma, 2008). According to World Health Organization (WHO), the prevalence of overweight (OV) and obesity has increased from 4% (1975) to over 18% (2016), and it is estimated that there are over 340 million obese children and adolescents aged 5 to 19 years today (World Health Organization, 2018). In response

Correspondence:

Borko Katanic
University of Nis, Faculty of Sports and Physical Education, Carnojevica 10/a, 18000, Nis, Serbia
E-mail: borkokatanic@gmail.com

to this alarming situation, the WHO adopted the Global Strategy on Diet, Physical Activity, and Health (World Health Organization, 2021).

Child nutrition is assessed by anthropometric measurements (Zdravković, Banićević, & Petrović, 2009). Morphological and nutritional status are important predictors of health status throughout life (Park, Falconer, Wiener, & Kinra, 2012; Pokos, Lauš, & Badrov, 2014), and therefore monitoring morphological and nutritional status in school-aged children is of multiple benefits (Vasiljević, Bjelica, & Gardašević, 2018; Veljković, Katanić, & Ilić, 2020; Katanić, Veljković, Prvulović, Banjević, & Tomić, 2022). Special attention should be paid to monitoring the development of children's morphological characteristics in order to determine the progress of the measured characteristics, but also the individual progress of each child (Ugrinić et al., 2019).

It is known that in addition to endogenous (internal) factors, exogenous (external) factors such as geographical, climatic, social, health, and physical factors influence the occurrence of obesity (Đurašković, 2002). Accordingly, some domestic researchers have tried to investigate whether there are regional differences in the morphological and nutritional status of children in Montenegro (Banjević, 2019; Zovko, Mitrović, and Ćorluka, 2020; Bjelica et al., 2021; Katanic et al., 2021). Considering that there is limited research on this topic and the data are variable, we wanted to investigate the current situation in more detail. Therefore, the aim of this study was to determine the differences in the morphological and nutritional status of school children in different regions of Montenegro. In this regard, it will be possible to provide guidelines for the practice of sports and physical activities.

Methods
Sample of respondents
A total of 97 girls of sixth grade participated in this transversal study. The sample was divided by regions (Vlada Crne Gore, 2011) into two groups, girls from the Central (n-55, 10.21±.72 years), and the Coastal region (n-42, 10.33±.59

years). Students are voluntary and with parental consent participated in the research process, also this research was carried out following the Helsinki Declaration.

Measurements
The standard international biological procedure was used to determine morphological characteristics (Eston & Reilly, 2013). Morphological characteristics were assessed using a battery of four variables: body height (BH), body weight (BW), waist circumference (WC), and hip circumference (HC). An anthropometer, caliper, and measuring tape were used for morphological measurements. To evaluate the body weight, Tanita's body fat scale - model BC-418MA, was used. BMI and waist-to-hip ratio (WHR) values were calculated according to standard formulas. The body mass index was calculated based on the standard formula: $BMI = BM (kg)/BH (m)^2$ (BM—body mass, BH—body height). WHR was calculated by dividing WC (in cm) by hip circumference (cm). The body mass index has a high correlation with the amount of body fat and for these reasons is used as an indicator of nutritional levels in children (Wilmore, Costill, & Kenney, 2008). We used WHO cutoff points for the assessment of the children's nutrition status (Onis et al., 2007).

Statistics
Basic parameters of descriptive statistics were calculated: arithmetic mean, standard deviation, and percentages. To determine differences in morphological characteristics groups, a t-test for small independent samples was used. For all statistical analyses, significance was accepted at $p<0.05$. Data processing was performed using the statistical program SPSS 26 (Statistical Package for Social Sciences, v26.0, SPSS Inc., Chicago, IL, USA).

Results
Table 1 shows that in the Central group, there are 58.1% normally nourished, 14.6% malnourished, and 27.3% obese, while in the Coastal region, 54.8% are normally nourished,

Table 1. Nutritional level for children expressed numerically and as a percentage by region.

	Central group n (%)	Coastal group n (%)	Total n (%)
Malnourished	8 (14.55)	9 (21.43)	17 (17.53)
Normal	32 (58.18)	23 (54.76)	55 (56.70)
Obese	15 (27.27)	10 (23.81)	25 (25.77)
Total	55	42	97

21.4% malnourished and 23.8% obese.

In Table 2, there is no significant difference between the girls of the central and southern regions in any variable of

morphological characteristics and BMI (body height, body weight, waist circumference, hip circumference, waist-to-hip ratio, BMI).

Table 2. T-test for differences in morphological characteristics between groups.

	Central group Mean±SD	Coastal group Mean±SD	t	p
Body height	145.41±8.02	146.59±7.87	-.721	.473
Body weight	38.19±7.69	39.08±9.02	-.522	.603
Waist Circumference	65.49±7.22	64.87±7.97	.398	.692
Hip Circumference	78.51±7.09	78.42±8.73	.055	.422
Waist-to-Hip Ratio	.84±.85	.83±.55	.519	.251
BMI	17.99±3.00	18.04±3.13	-.85	.933

Legend: Mean = Arithmetic mean; SD = Standard deviation; t = t-test value; p = Statistical significance.

Discussion

This study aimed to examine the influence of two regional zones in Montenegro on morphological differences and the nutritional status of school girls. The sample was divided by regions into two groups, girls from the Central region (n-55, 10.21±.72 years), and the Coastal region (n-42, 10.33±.59 years). 27.27% of girls from the Central region are obese compared to 23.81% of obese in the Coastal region. When comparing groups by regional zones, it is noticeable that there is no significant difference in morphological characteristics and body mass index.

There are papers on this topic, but when it comes to comparing the results of this study, they should be compared to the results of other studies that included a similar sample of subjects. And such studies are not many.

The results of girls in the central region approximately correspond to the average values of obese children (27.3%) from previous studies (Đorić & Vukićević, 2020; Bjelica et al., 2021; Katanic et al., 2021), while the Coastal group had slightly lower values (23.8). Certainly, the percentage of obese children in both groups of our study was much lower than in the study conducted in Serbia on a large sample of ten-year-old children (n-344), where even 42% of the respondents were overweight (Stamenković, Danković, Stanković, Stojanović, & Paunović, 2020).

When analyzing the morphological parameters, it is noticeable that the height of our subjects corresponds to the height of the subjects from the study (Đorić & Vukićević, 2020), and is slightly lower compared to children from recent studies (Bjelica et al., 2021; Katanić et al., 2021). In contrast, higher values were obtained than in children one year younger (Vasiljević, Bjelica, & Gardašević, 2018). When body weight is observed, it is in line with previous children of that age (Vasiljević et al., 2018; Đorić & Vukićević, 2020; Bjelica et al., 2021; Katanić et al., 2021). Also, BMI approximately corresponds to the values of children from previous studies (Vasiljević et al., 2018; Đorić & Vukićević, 2020; Bjelica et al., 2021; Katanić et al., 2021). When it comes to the average values of hip and waist circumference in our research, they approximately correspond to the values in other studies (Đorić & Vukićević, 2020; Bjelica et al., 2021; Katanić et al., 2021). In general, it was indicated that the anthropometric values of our respondents are in accordance with the values of children from these areas.

However, it should be emphasized that there was no sig-nificant difference between the groups of children from the central and coastal regions in any morphological parameter. In the previous research (Bjelica et al., 2021) it was shown that children from Coastal had higher values in body mass and BMI, which was not the case in this research.

The obtained results indicate that every 4th-grade school child is overweight. Data variations also exist in relation to different EU countries, so the prevalence of obesity varies from 13% in Finland, 16% in the Czech Republic, 33% in Greece, to 36% in Italy (Cali & Caprio, 2008). So, it is clear that the prevalence of obesity in the world is constantly increasing in the last 2-3 decades (Lobstein & Frelut, 2003; World Health Organization, 2021).

Based on the given information, it can be concluded that it is not enough to just point out the problem, it is also necessary to offer a solution. Stankovic, Djordjevic, Hadzovic, Djordjevic, & Katanic (2021) based on a systematic review indicate that physical activities have a positive effect on obesity in children regardless of the age of the respondents. In line with that, other authors point out that physical activity is considered a key factor for healthy psycho-physical development of children (Dencker & Andersen, 2008; Ortega, Ruiz, Castillo, & Sjöström, 2008) and therefore it is necessary to promote children's sports and physical activities. In particular, the recommendations of Rodriguez-Martinez et al. (2020) emphasize that policies and interventions at home, at schools, in the community, and through the health system should be motivated to support the healthy growth and development of children, by improving nutrition and levels of physical activity.

In addition to several limitations that this study has, the main one relates to the narrower system of included morphological variables, as well as to the transversal study. Therefore, the proposal for further research is to carry out the treatment of physical exercise while examining the morphological and nutritional status.

Conclusion

The obtained results indicate that every fourth child is overweight. As well as that there is no difference between the groups of respondents in relation to the regional division. However, due to certain limitations, these results should be taken with a grain of salt. However, this does not diminish the value of this study, which actually indicated the great importance of monitoring certain parameters of growth and development in children of younger school age.

Reference
Barnett, L. M., Lai, S.K., Veldman, S.L., Hardy, L.L., Cliff, D.P., Morgan, P.J., ... & Okely, A.D. (2016). Correlates of gross motor competence in children and adolescents: A systematic review and meta-analysis. *Sports Medicine, 46*(11), 1663-1688.

Banjevic. B. (2019). Differences in some morphological characteristics and body mass index in children of younger school age with reference to their gender. *Journal od Anthropology of Sport and Physical Education, 3*(3). 37-41.

Banjevic, B., Aleksic, D., Aleksic Veljkovic, A., Katanic, B., & Masanovic, B. (2022). Differences between Healthy-Weight and Overweight Serbian Preschool Children in Motor and Cognitive Abilities. *International Journal of Environmental Research and Public Health, 19*(18), 11325.

Bjelica, D., Katanic, B., Corluka, M., Zovko, I. C., Gardasevic, J., & Pehar, M. (2021). Differences in Morphological Characteristics and Nutritional Status of School Children according to Different Regions in Montenegro. *Homosporticus, 23*(2), 46-50.

Cali, A.MG., & Caprio, S. (2008). Obesity in children and adolescents. *Journal of Clinical Endocrinology & Metabolism, 93*(11). 31-36.

Colley, R.C., Garriguet, D., Adamo, K.B., Carson, V., Janssen, I., Timmons, B.W., & Tremblay, M.S. (2013). Physical activity and sedentary behavior during the early years in Canada: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1), 1-9.

Dencker, M., & Andersen, L.B. (2008). Health-related aspects of objectively measured daily physical activity in children. *Clinical Physiology and Functional Imaging, 28*(3), 133-144.

Dikanovic, V., & Vignjevic, Z. (2009). Gojaznost dece uzrasta 7 do 15 godina i rizik za pojavu dijabetes mellitusa tipa 2. Živić, S., Ed In *42. Pedijatrijski Dani Srbije Sa Medunarodnim Učešćem, p. 117*. Udruženje Pedijatra Srbije: Niš, Serbia.

Đurašković. R. (2002). *Sportska medicina*. Niš: SIA.

Đoric, N., & Vukicevic, V. (2020). Nutritional Status of Young School Children in a Rural Environment in Srem District. *Journal od Anthropology of Sport*

and Physical Education. 4(2). 19-21.

Elmesmari, R., Martin, A., Reilly, J.J., & Paton, J.Y. (2018). Comparison of accelerometer measured levels of physical activity and sedentary time between obese and non-obese children and adolescents: a systematic review. *BMC Pediatrics, 18*(1), 1-22.

Eston, R., & Reilly, T. (2013). *Kinanthropometry and Exercise Physiology Laboratory Manual: Volume Two: Physiology.* London: Routledge.

Katanić, B., Veljković, A.A., Prvulović, N., Banjević, B., & Tomić, I. (2022). Relationship between Fine Motor Skills and BMI of Preschool Children. *Journal of Anthropology of Sport and Physical Education, 6*(3), 23-26.

Katanic, B., Zovko, I.C., Bjelica D., Nokic A., Pehar, M., & Corluka, M. (2021). Morphological Characteristics and Nutritional Status in School Children. *Homosporticus, 23*(2), 28-32.

Kumar, S., & Kaufman, T. (2018). Childhood obesity. *Panminerva Medica, 60*(4), 200-212.

Lobstein, T., & Frelut, M. (2003). Prevalence of overweight among children in Europe. *Obesity Reviews, 4*(4), 195-200.

Onis, M.D., 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*, 660–667.

Ortega, F.B., Ruiz, J.R., Castillo, M.J., & Sjöström, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. *International Journal of Obesity, 32*(1), 1-11.

Park, M.H., Falconer, C., Viner, R.M., & Kinra, S. (2012). The impact of childhood obesity on morbidity and mortality in adulthood: A systematic review. *Obesity Reviews, 13*(11), 985-1000.

Pokos, H., Lauš, D., & Badrov, T. (2014). Razvoj stanja uhranjenosti petogodišnjih djevojčica i dječaka od 2008. do 2012. godine (Development of nutritional status of five-year-old girls and boys from 2008th to 2012th). *Sestrinski Glasnik, 19*(1), 17-21

Rodriguez-Martinez, A., Zhou, B., Sophiea, M.K., Bentham, J., Paciorek, C.J., Iurilli, M.L., ... & Boggia, J.G. (2020). Height and body-mass index trajectories of school-aged children and adolescents from 1985 to 2019 in 200 countries and territories: a pooled analysis of 2181 population-based studies with 65 million participants. *The Lancet, 396*(10261), 1511-1524

Spiotta, R.T., & Luma, G. B. (2008). Evaluating obesity and cardiovascular risk factors in children and adolescents. *American Family Physician, 78*(9),

1052-1058.

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.

Stamenković, S., Danković, G., Stanković, N., Stojanović, N., & Paunović, M. (2020). Trend change in the morphological features of boys aged seven to ten. *Facta Universitatis. Series: Physical Education and Sport*, (1), 103-118.

Ugrinić B., Katanić B., Ilić P., Prvulović N., Novaković V., Stanković M., & Božić S. (2019). Razlike u morfološkim karakteristikama i motoričkim sposobnostima dece predškolskog uzrasta. U: *Zbornik radova III međunarodne naučne konferencije "Sport, rekreacija, zdravlje"* (409-414). Beograd: Visoka sportska i zdravstvena škola.

Vasiljević, I., Bjelica, D., & Gardašević, J. (2018). Analysis of nutrition for boys and girls who are first cycle pupils in primary school. *Acta Kinesiologica, 12*(1), 106-110.

Veljković, A.A., Katanić, B., & Ilić, P. (2020). Differences in Coordination Between Normal and Over-Weight Children Aged 7 Years. *Journal of Athletic Performance and Nutrition, 7*(1), 01-10.

Vlada Crne Gore (2011). *Zakon o regionalnom razvoju.* Retrieved from /https://www.gov.me/dokumenta/88597c9c-f382-46a5-a734-7b1cdb9c1f74

Zdravković, D., Banićević, M., & Petrović, O. (2009). *Novi standardi rasta i uhranjenosti dece i adolescenata. Priručnik za pedijatre i saradnike u primarnoj zdravstvenoj zaštiti* (str. 57-83). Beograd: Udruženje pedijatara Srbije.

Zovko, I.C., Mitrovic, M., & Corluka, M. (2020). Comparative Analysis of Anthropometric Parameters as Obesity Indicators for Sixth Grade Boys from Different Regions in Montenegro. *Journal of Anthropology of Sport and Physical Education, 4*(1), 27-31.

World Health Organisation (2018). *Obesity and overweight.* Geneva. CH: WHO.

World Health Organization (2021). *Obesity and overweight.* Retrieved from https://www.who.int/en/news-room/factsheets/detail/obesity-and-overweight (accessed on 24. November 2021).

Wilmore, J.H., Costill, D.L., & Kenney, W.L. (2008). Body composition in sport. In *Physiology of Sport and Exercise, 4th ed.; Wilmore, J., Costill, D.L., Eds.;* Human Kinetics: Champaign, IL, USA, pp. 318–327.