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DIFFERENCES IN MORPHOLOGICAL CHARACTERISTICS AND NUTRITIONAL STATUS OF SCHOOL CHILDREN ACCORDING TO DIFFERENT REGIONS IN MONTENEGRO: ORIGINAL STUDY

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Abstract
The problem of the growth of children is very current at a time, so it is extremely important to monitor the morphological and nutritional status of children. This study aimed to determine the differences in morphological and nutritional status of children in different regions in Montenegro. The research included a sample of 40 respondents, fifth-grade children from two primary schools belonging to different regions in Montenegro. Children attending primary school in Budva, Primorska region (n-20, 10,91 ± 0,33 years), and school in Nikšić, Central region (n-20, 10,83 ± 0,27 years). Morphological characteristics were assessed using a battery of four variables: body height, body weight, waist circumference, and hip circumference. Body mass index was calculated, and then the children were classified according to their nutritional status. The significance of differences between children living in different regions was determined by a t-test for independent samples. The nutritional status of children indicates that 14 children (70%) from the coastal region belong to the group of normally fed, while six children (30%) are overfed. When it comes to the situation with children from the central region, the ratio of normally and overfed children is 15 (75%) to five (25%). The obtained results indicate that every fourth child is obese, as well as that children from coastal areas have significantly higher values in the two of five parameters body weight (,007), and higher body mass index (,026) compared to children from the central region.

Key words: *anthropometric characterises, BMI, region differences, pupils, Montenegro*

Introduction

Nowadays, children are spending more and more time in sedentary activities such as playing video games or using the Internet, which reduces the time allotted for physical activities and plays. Insufficient physical activity (hypokinesia), according to the report of the World Health Organization (WHO), has been declared an independent risk factor and is in the 4th place on the world list of risk factors (World Health Organization, 2003). While combined with a sedentary lifestyle and poor diet leads to obesity in children (Planinsec & Matejek, 2004; Mendonça & Anjos, 2004) which is associated with many health problems such as diabetes mellitus type 2, asthma, hypertension, psychosocial problems, early atherosclerosis, etc. (Dikanović & Vignjević, 2009).
Obesity is increasingly present among the child population and we are witnessing it take on epidemiological proportions and is currently one of the most common public health problems (Kumar & Kaufman, 2018). Recent research on a large sample of children has found a marked trend of increasing overweight and obesity in the last two decades (Wang & Lobstein, 2006; Ogden et al., 2016; Abarca-Gómez et al., 2017; Skinner, Ravanbakht, Skelton, Perrin & Armstrong, 2018; Boddy & NCD Risk Factor Collaboration, 2021). According to the WHO, the prevalence of overweight and obesity has increased from 4% (1975) to over 18% (2016) and it is estimated that today there are over 340 million obese children and adolescents aged 5 to 19 years (WHO, 2018), ie according to Spiotta & Luma (2008) almost a third (31%) of children in the world aged 6 to 19 have a bodyweight above normal values.

The nutritional status of children is assessed by anthropometric measurements (Zdravković, Banićević,

& Petrović, 2009) and this is extremely important, especially when it is known that monitoring morphological changes can be crucial in preventing and treating obesity (Popovic, Bjelica, Masanovic, & Vukotic, 2018; Masanovic, Vukotic, Bjelica & Popovic, 2018), and therefore more and more authors have recently been working to determine the morphological and nutritional status of children (Gardasević, Bjelica, Popovic, & Vasiljevic, 2015; Vasiljevic, Bjelica, Popovic, & Gardasevic, 2015; Ćorluka, Bjelica, & Gardašević, 2018; Vasiljević, Bjelica, & Gardašević, 2018; Banjevic, 2019; Ugrinić et al., 2019; Bacovic, 2020; Veljković, Katanić, & Ilić 2020; Stankovic, Djordjevic, Hadzovic, Djordjevic, & Katanic, 2021).
It is known that the occurrence of obesity, in addition to endogenous (internal), is also influenced by exogenous (external) factors such as geographical, climatic, social, health, as well as physical activity (Đurašković, 2002). Accordingly, some domestic researchers sought to examine whether there are regional differences in the morphological and nutritional status of children in Montenegro (Banjevic, 2019; Bacovic, 2020; Zovko, Mitrovic, & Corluka, 2020). Given that there is a small amount of research on this topic, and that the data are variable, we wanted to examine in more detail what the current situation is. So, this study aimed to determine the differences in morphological and nutritional status of children in different regions in Montenegro. In this regard, it will be possible to provide guidelines on participation in sports and physical activities.

Methods

Sample of respondents

A total of 40 children of sixth grade participated in this transversal study. The sample was divided by regions (Vlada Crne Gore, 2011) into two groups, children from the Coastal region (n=20) aged 10,91±0,33 years, and from the Central region of Montenegro (n=20) aged 10,83±0,27 years. Students are voluntary and with parental consent participated in the research process, also this research was carried out following the Helsinki Declaration.

The sample of variables

Morphological characteristics of children were determined using standardized anthropometric instruments and according to the standard international biological procedure (Eston & Reilli, 2013). Five morphological parameters were measured: body height, body weight, waist circumference, hip circumference, and body mass index.
Body height was measured with an anthropometer. Respondents stood barefoot on a flat surface, in an upright position, with relaxed shoulders and bent heels. Their heads were arranged so that the Frankfurt horizontal was in a horizontal position. Bodyweight was measured with a medical scale, on which the subjects stood calmly barefoot in an upright position. Waist and hip circumference were measured with an inelastic centimetre tape, for the first measure in the middle of the distance between the top of the pelvis and chest, respectively, for the second measure above the line separating the thigh from the thigh at the point where the maximum circumference is over the back.

Body mass index was calculated based on the formula: $BMI = BM(kg)/BH^2(m^2)$ and it is used as an indicator of nutritional levels and has a high correlation with the amount of body fat (Vilmore, Costill, & Kenney, 2008). Children were classified according to BMI into three groups: malnourished, normal, and overfed. The distribution according to the nutritional status was performed according to the reference values of the World Health Organization for the body mass index for the age and sex of children (Onis et al., 2007).

Data processing

Basic parameters of descriptive statistics were calculated: arithmetic mean, standard deviation, minimum, maximum. to determine differences in morphological characteristics among groups of sixth-grade children by region, a T-test for small independent samples was used. 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 the descriptive parameter of morphological characteristics of children, more precisely arithmetic means, standard deviation, minimum and maximum. These data were calculated for all children and presented about different regions, as well as by gender. It is noticeable that children from the coastal region achieved higher numerical values in all parameters than children from the central region. Also, it should be added that boys achieved higher values than girls in most parameters, and that is true for the both regions.

Table 1. Descriptive statistics of morphological characteristics of children by regions

		Coastal region				Central region			
		Mean	SD.	Min	Max	Mean	SD.	Min	Max
Age	Boys	10.92	0.32	10.42	11.33	10.87	0.28	10.42	11.33
	Girls	10.91	0.38	10.58	11.75	10.79	0.28	10.42	11.25
	Total	10.91	0.33	10.42	11.75	10.83	0.27	10.42	11.33
Body height	Boys	151.08	4.1	142	158	147.9	5.92	141	157
	Girls	151.75	5.23	145	159	147.7	8.08	139	164
	Total	151.35	4.46	142	159	147.8	6.89	139	164
Body mass	Boys	43.92	7.56	37	59	37.4	5.02	31	45
	Girls	43.13	5.69	37	55	38.1	7.62	28	54
	Total	43.6	6.72	37	59	37.75	6.29	28	54
BMI	Boys	19.18	2.73	16.89	24.88	17.1	2.07	14.35	19.62
	Girls	18.74	2.29	15.22	21.76	17.38	2.63	14.29	22.19
	Total	19	2.51	15.22	24.88	17.24	2.31	14.29	22.19
Hip circumference	Boys	68.5	10.88	59	92	67	4.57	61	76
	Girls	67.25	7.42	59	79	66.1	5.45	57	77
	Total	68	9.45	59	92	66.55	4.91	57	77
Waist circumference	Boys	82.08	7.83	74	97	79	5.58	71	87
	Girls	82.75	6.41	77	93	77.7	7.17	67	89
	Total	82.35	7.13	74	97	78.35	6.29	67	89

Note: Mean-Arithmetic mean. SD.-Standard deviation. Min-Minimum. Max-Maximum

Table 2 shows the nutritional level according to which the children were classified as malnourished, normal, and overfed. Also. an overview was provided by regions and by gender. Looking at the total sample, it is noticeable that no children were malnourished. The ratio of normally and overfed children is 29 (72.5%) versus 11 (27.5%). That is, every fourth child is obese. When comparing the ratio of normally and overfed children to the regions, the ratio is quite similar, ie 14:6 in the coastal and 15:5 in the central region. The ratio of normally and over nourished to boys is similar in both regions, while there are differences in girls compared to regions, so in coastal. the yield is 5:3, while in central 8:2 is on the side of normally fed versus obese girls.

Table 2. Nutritional level for children expressed numerically and as a percentage by regions

	Coastal region			Central region			
	Boys	Girls	Total	Boys	Girls	Total	
	12	8	20	10	10	20	
	60%	40%	100%	50%	50%	100%	Total
Under weight	0	0	0	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%
Normal weight	9	5	14	7	8	15	29
	75%	62.5%	70%	70%	80%	75%	72.5%
Pre obese	3	3	6	3	2	5	11
	25%	37.5%	30%	30%	20%	25%	27.5%

Comparing the results between children from the coastal and the central region. it is noticeable that children from the coastal achieved higher numerical values in all morphological parameters. Based on the t-test (Table 3). it is noticeable that children from the coastal region achieved significantly higher values than children from the central region in two of the five variables. body mass (.007) and BMI (.006). In other anthropometric parameters. there was no significant difference between the two groups.

Table 3. T-test for differences in morphological characteristics between groups

	Coastal region	Central region	t	p
Body height	151.35	147.80	1.933	.062 ^
Body mass	43.60	37.75	2.842	.007*
BMI	19.00	17.24	2.312	.026*
Waist circumference	68.00	66.55	0.609	.547 ^
Hip circumference	82.35	78.35	1.883	.067 ^

Note: t - t values. p - statistical significance.
*^ -non-significant; * - significant*

Discussion

Children from the coastal region achieved the following results: 14 children (70%) were normal weight. 6 (30%) were overweight, and there were not malnourished. When it comes to the situation with children from the central region, the ratio of normally and overfed children is 15 (75%) to 5 (25%). The children from coastal areas have significantly higher body weight (.007), and a higher body mass index (0.26) compared to children from the central region.

When it comes to the nutritional status of sixth-grade primary school children, the results obtained indicate that every fourth child is obese. Which roughly corresponds to the average values of overweight and obese children in other studies (Djoric & Vukicevic., 2020; Katanic et al., 2021). While the situation is better than the one study in Serbia (Stamenković, Danković, Stanković, Stojanović & Paunović., 2020) whereas many as 42% of respondents are overfed and obese.

When observing anthropometric parameters, it is noticeable that the average body height of our respondents corresponds to the values of children from the central region, and is lower than children from the southern and northern region Montenegro (Zovko et al., 2020) for the same age. Also, correspond to the values of children from the study of Katanic et al. (2021), and are larger than the groups of malnourished and normally malnourished children from the Eastern part of Serbia (Stamenković et al., 2020) and children from the study of domestic authors (Vasiljević, Bjelica, & Gardašević., 2018). Although, the last study deals with respondents who

are one year younger. Insight into the parameters of body weight, as well as waist and hip circumference, shows that children from this study achieved lower values than peers in the same studies (Djoric & Vukicevic, 2020; Stamenkovic et al., 2020), and higher than children from the study of Vasiljević et al. (2018).

Based on the t-test it was determined that children from the coastal region achieved significantly higher values than children from the central region in two of the five variables, body mass (.007) and BMI (.026). In the study of Zovko et al. (2020) also examined the difference by regions of children of the same age and the authors state that there is a mismatch between the results of different parameters of the degree of nutrition, but that in general, the study did not find differences between groups. Although analyzing coastal and central regions, coastal achieved numerically higher values in all parameters. As is the case in this study is mentioned cases. These are studies that include small samples, so take the data vary considerably. For more detailed conclusions should be conducted studies on a large sample or the National Report on Childhood Nutrition in Montenegro similar to Western countries (Cali & Caprio. 2008), based on which it was concluded that the prevalence of obesity in European countries varies from 13-36%.

Insufficient physical activity has the greatest impact on the increase in obesity in children and adolescents. In addition to inadequate nutrition, children are less and less involved in physical activities. Especially in activities of moderate to high intensity (Treuth et al., 1998; Belcher et al., 2010), recommended by the WHO (2010) in a minimum of 60 minutes per day. The data of Boreham & Riddoch (2001) is also worrying, that children consume 600 kcal less per day than their peers 50 years ago. That is why leading health organizations promote physical activities in children, pointing to short-term and long-term health benefits (Aleksić-Veljković, Katanić, & Mašanović., 2021). Particular attention should be paid because obese children are 10-12 times more likely to be obese in adulthood than normally fed children (Whitaker, Jarvis, Beeken, Boniface & Wardle., 2010). Parents also play an important role in this, especially when it is known that parental physical inactivity strongly influences children's inactivity (Sothern, 2004; Masanovic, Popovic, Bjelica, & Gardasevic. 2020) and therefore parents must be appealed to influence their example on children. It is not enough for parents to just talk to their children, but they must be more active for children to adopt a given model of behaviour.

The limitation of the study is reflected in a small sample, a narrower system of included morphological variables, as well as a comparison of the two regions. In this regard, the recommendations for future research would be to include a large sample, all regions of Montenegro, as well as a broader system of morphological parameters. and then have a more complete picture of the morphological nutritional status of children. After that, it would be possible to give certain guidelines regarding sports and physical activities.

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