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Physical Activity and Nutritional Status of Schoolchildren in Montenegro

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Abstract

This study aimed to investigate the association between nutritional status and physical activity in urban and rural school children in Montenegro, by presenting part of the results of the national survey on childhood obesity in Montenegro (2013-2015). The sample included 4725 Montenegrin children: 2381 (50.4%) boys and 2344 (49.6%) girls. The self-administered part of the questionnaire for parents included four questions on children's physical activity. Anthropometric measurements were taken in schools. Nutritional status was assessed according to the criteria of the U.S. Centers for Disease Control and Prevention (CDC). In the present study, boys reported more physical activity than girls did (sports, outdoor play, etc.). The reported share of engagement in various team sports (football, basketball) was also higher among the boys than the girls. Rural children reported being more physically active than children in urban areas, and their scheduled physical education classes attendance was higher compared with their urban peers. There were no differences between children in rural and urban areas with respect to participation in individual/team sports. Obese children reported a significantly lower level of physical activity compared with normal-weight children. The obtained results suggest that the promotion of physical activity should be emphasized in an interdisciplinary as a way of prevention of childhood obesity as one of the significant public health challenges in the 21st century.

Keywords: *children, physical activity, nutritional status, urban, rural*

Introduction

Obesity is a complex multifactorial disease with numerous biological, behavioural and environmental determinants (Mead et al., 2017). Childhood obesity has become a leading public health challenge of the 21st century. According to the World Health Organization (WHO), globally, in 2016, the number of overweight children under the age of five was estimated to be over 41 million (World Health Organization, 2020). Additionally, over 340 million children and adolescents aged 5–19 were overweight or obese in 2016. The prevalence of overweight and obesity among children and adolescents aged 5–19 has risen dramatically worldwide from just 4% in 1975 to over 18% in 2016; the rise has occurred similarly among both boys and girls (World Health Organization, 2020). According to the recent Montenegrin national survey data, the overall percentage of Montenegrin schoolchildren who were overweight or obese (U.S. Centers of Disease Control and Prevention -CDC criteria) was 24.5%, of which 9% were obese (Martinovic et al., 2015).

Childhood obesity is associated with adverse consequences, such as psychological problems and lower educational attainment, and a higher risk of many harmful comorbidities later in life, including type 2 diabetes mellitus, dyslipidemia, non-alcoholic fatty liver disease, coronary heart disease, hypertension, locomotor disorders, infertility, and even cancer (Spinelli et al., 2019; World Health Organization, 2020). According to some researchers, childhood obesity is affecting mainly low and middle-income countries, particularly in urban settings (World Health Organization, 2020), although some systematic reviews and meta-analyses provide evi-

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dence that raised odds of childhood obesity are found more in rural areas (J. A. Johnson & A. M. Johnson, 2015). However, most evidence shows that regardless of whether children live in an urban or rural setting, the increasingly digitalized world conquers both areas and offers fewer opportunities for physical activity through healthy play (World Health Organization, 2020). It seems that being overweight or obese further reduces children's opportunities to participate in individual or group physical activities, which is often a circulus vitiosus problem: children become even less physically active, which makes them likely to become more overweight and obese over time (World Health Organization, 2020). Many children nowadays grow up in an obesogenic environment that promotes energy imbalance through the marketing, advertising, affordability and availability of energy-dense foods, coupled with decreases in physical activity and increases in sedentary lifestyle habits (playing computer games, watching TV, etc.) (Mead et al., 2017). Consistently with this, some data show that children today are about 15% less fit compared with how fit their parents were when they were young (Chen, Hammond-Bennett, Hypnar, & Mason, 2018).

Regular physical activity in children and adolescents promotes health and fitness. Authorities recommend that children and adolescents aged 6 to 17 engage in 60 minutes or more of moderate-to-vigorous physical activity daily. Compared with those who are inactive, physically active youth have higher levels of fitness, lower body fat, stronger bones and muscles and lower risk of cardiometabolic diseases (U.S. Department of Health and Human Services, 2018).

Many epidemiological studies have confirmed this close association between physical activity, physical fitness and adiposity in school-aged children and youth, while longitudinal studies reported an unquestionable inverse relationship between body mass index (BMI) and physical fitness (Koulouvaris, Tsolakis, Tsekouras, Donti, & Papagelopoulos, 2018). Therefore, physical activity should be considered very important for promoting good health in children. Children spend half of their daily hours and consume at least one-third of their daily calories at school; thus, schools are recognized as an ideal place for implementing the obesity interventions to most children (Liu et al., 2019).

The goal of obesity prevention can be achieved by improvement of energy balance-related behaviours, which includes both physical activity and dietary improvement, which can be changed through the environmental influence, especially physical education curriculum improvement (Liu et al., 2019).

This study aimed to investigate the association between nutritional status and physical activity in urban and rural school children in Montenegro.

Methods

We performed a cross-sectional national study among Montenegrin elementary school children from second to seventh grade. Details of data collection methods have been described in previous reports (Martinovic et al., 2015). The final sample included 2381 (50.4%) boys and 2344 (49.6%) girls, aged 7–13 years (mean±SD=9.79±1.71 years).

In the national study, the parental questionnaire was self-administered and consisted of five parts. For this study, we chose the parts of the questionnaire related to gender, age, urban vs rural residential area, and child's physical activity. The questions on physical activity were taken from a standardized questionnaire (Kerr et al., 2008) and were related to various types of school and out-of-school physical activities (individual/team sports, walk to school, outdoor play, etc.) weekly, at least one hour per day.

Weight measurements were performed on barefoot children in light clothes on a digital scale with accuracy up to 0.1 kg. Body height was measured with stadiometer with accuracy up to 0.5 cm. Body mass index (BMI) was calculated by dividing their body weight in kilograms by the square of their height in metres.

We assessed the children's nutritional status using anthropometric criteria of the U.S. Centers for Disease Control and Prevention. In CDC Growth Charts for children and adolescents age 2 to 19, BMI is assessed by age- and sex-specific percentiles: underweight is < 5th percentile; normal weight is 5th percentile to less than the 85th percentile; overweight is the 85th percentile to less than the 95th percentile, and obesity is ≥ 95th percentile (Centers for Disease Control and Prevention, 2018).

Statistical analysis was performed in IBM SPSS Statistics for Windows, Version 22.0. The chi-square test was used to test the difference in response frequency with respect to gender, urban/rural residence and nutritional status of children based on CDC anthropometric assessment criteria (p-value less than 0.05 was considered significant).

Results

A small percentage of children (0.8% of boys and 1.6% of girls) reported not being physically active at least one hour per

Table 1. Frequency of responses by gender, place of residence of children (rural/urban) and nutritional status for the question: Over a typical or usual week on how many days is your child physically active for a total of at least 60 minutes per day? Response rate: 95%

	0 days	1 day	2 days	3 days	4 days	≥ 5 days	p
Gender				**Number (%)**			
Boy	19 (0.8)	84 (3.7)	166 (7.3)	237 (10.4)	241 (10.6)	1524 (67.1)	<0.001
Girl	35 (1.6)	87 (3.9)	189 (8.5)	316 (14.2)	261 (11.7)	1345 (60.2)	
Urban/rural							
Rural	5 (0.6)	25 (3.1)	72 (8.9)	116 (14.3)	73 (9.0)	520 (64.1)	0.029
Urban	44 (1.4)	129 (4.2)	251 (8.1)	375 (12.1)	361 (11.6)	1942 (62.6)	
Nutritional status							
Underweight	1 (0.4)	11 (4.2)	23 (8.8)	38 (14.5)	23 (8.8)	166 (63.4)	0.001
Normal weight	36 (1.1)	123 (3.9)	257 (8.1)	372 (11.8)	327 (10.4)	2044 (64.7)	
Overweight	5 (0.7)	19 (2.8)	48 (7.0)	92 (13.4)	91 (13.2)	433 (62.9)	
Obese	12 (3.0)	18 (4.6)	27 (6.8)	51 (12.9)	61 (15.4)	226 (57.2)	

Legend: p - statistical significance

day a week (Table 1). Most examined children (boys and girls) reported being physically active for at least one hour, five days a week (sports, walk to school, outdoor play, etc.). Boys more frequently reported being physically active for at least one hour during four or more days a week; this difference was statistically significant when compared to girls (67.1% vs 60.2%; p<0.001). Most children from both rural (64.1%) and urban areas (62.6%) reported being physically active for at least one hour during five or more days a week (Table 1). A statistically significant difference was found between rural and urban children in respect to their physical activity responses, in favour of rural children. Children who live in rural areas of Montenegro reported being more physically active during the week when compared to their urban peers (p=0.029). In all four nutritional status categories of children, the most frequent response given regarding physical activity was "at least one hour during five or more days weekly". The most physically active were normal-weight children. In contrast, obese children reported lower levels of physical activity than their normal-weight peers did (p=0.001) (Table 1).

Boys' participation in team sports was significantly higher than girls' participation (p<0.001) although more than a third of the boys and more than half of the girls were not involved in club sports (football, basketball, etc.). There was no difference in club or team sport participation between rural and urban children (p=0.491). The majority of children in all four categories of nutritional status responded not being involved in any team sport (underweight 53.2%, normal-weight 44.7%, overweight 46.0%, obese 43.4%), while a statistically significant difference was observed between the responses (p=0.021) (Table 2).

Table 2. Frequency of answers by gender, place of residence of children (rural/urban) and nutritional status to the question: Outside of school, how many days per week does your child play or practice team sports? Response rate: 93%

	0 days	1 day	2 days	3 days	4 days	≥ 5days	p
Gender				**Number (%)**			
Boy	820 (36.8)	122 (5.5)	252 (11.3)	562 (25.2)	209 (9.4)	266 (11.9)	<0.001
Girl	1163 (54.0)	164 (7.6)	357 (16.6)	273 (12.7)	91 (4.2)	104 (4.8)	
Urban/rural							
Rural	358 (45.7)	63 (8.0)	109 (13.9)	134 (17.1)	55 (7.0)	65 (8.3)	0.491
Urban	1359 (45.7)	187 (6.2)	422 (13.9)	602 (19.8)	214 (7.0)	252 (8.3)	
Nutritional status							
Underweight	132 (53.2)	26 (10.5)	25 (10.1)	31(12.5)	13 (5.2)	21 (8.5)	0.021
Normal weight	1370 (44.7)	208 (6.8)	432 (14.1)	574 (18.7)	216 (7.0)	268 (8.7)	
Overweight	313 (46.0)	31 (4.6)	85 (12.5)	155 (22.8)	45 (6.6)	51 (7.5)	
Obese	168 (43.4)	21 (5.4)	67 (17.3)	75 (19.4)	26 (6.7)	30 (7.8)	

In our study, 63.6% of the boys and 59.3% of the girls were not engaged in non-team (individual) sports in general. Among the children who do participate in non-team sports, the share of boys versus the girls was significantly higher (p<0.001). There were no significant differences in the physical activity between urban and rural children (p=0.224); moreover, most children from both rural and urban areas (about 60%) reported not playing any non-team sports (Table 3).

Table 3. Frequency of responses by gender, place of residence of children (rural/urban) and nutritional status to the question: Outside of school, how many days per week does your child have activity training or instruction not in a team sport (e.g., martial arts, dance, tennis)? Response rate: 91%

	0 days	1 day	2 days	3 days	4 days	≥ 5days	p
Gender				**Number (%)**			
Boy	1359 (63.6)	125 (5.8)	196 (9.2)	269 (12.6)	76 (3.6)	112 (5.2)	<0.001
Girl	1269 (59.3)	207 (9.7)	352(16.4)	186 (8.7)	61 (2.8)	66 (3.1)	
Urban/rural							
Rural	475 (61.1)	66 (8.5)	88 (11.3)	97 (12.5)	24 (3.1)	27 (3.5)	0.224
Urban	1809 (61.3)	224 (7.6)	402 (13.6)	299 (10.1)	95 (3.2)	121 (4.1)	
Nutritional status							
Underweight	162 (66.4)	31 (12.7)	22 (9.0)	21 (8.6)	3 (1.2)	5 (2.0)	0.002
Normal weight	1829 (61.0)	247 (8.2)	384 (12.8)	305 (10.2)	100 (3.3)	134 (4.5)	
Overweight	407 (61.4)	37 (5.6)	85 (12.8)	87 (13.1)	22 (3.3)	25 (3.8)	
Obese	230 (61.8)	17 (4.6)	57 (15.3)	42 (11.3)	12 (3.2)	14 (3.8)	

We found no significant difference between reported physical education class attendance in terms of gender (p=0.091) and nutritional status (p=0.205). A significant difference between physical education class attendance was observed between rural and urban children (p<0.001). Rural children's attendance in physical education classes was much higher compared to that of urban children (Table 4).

Table 4. Frequency of responses by gender, place of residence of children (rural/urban) and nutritional status: How many days per week does your child have gym or physical education class at school? Response rate: 95%

	0 days	1 day	2 days	3 days	4 days	≥ 5days	p
Gender				**Number (%)**			
Boy	32 (1.4)	72 (3.2)	486 (21.9)	1448 (65.2)	163 (7.3)	21 (0.9)	<0.091
Girl	30 (1.3)	76 (3.4)	521 (23.4)	1459 (65.5)	132 (5.9)	9 (0.4)	
Urban/rural							
Rural	5 (0.6)	20 (2.5)	139 (17.3)	561 (70.0)	73 (9.1)	4 (0.5)	0.001
Urban	50 (1.6)	115 (3.8)	732 (23.9)	1952 (63.8)	187 (6.1)	25 (0.8)	
Nutritional status							
Underweight	3 (1.2)	6 (2.3)	60 (23.1)	180 (69.2)	11 (4.2)	0 (0.0)	0.205
Normal weight	40 (1.3)	102 (3.3)	716 (22.9)	2038 (65.2)	209 (6.7)	19 (0.6)	
Overweight	12 (1.8)	19 (2.8)	136 (20.1)	455 (67.3)	47 (7.0)	7 (1.0)	
Obese	7 (1.8)	21 (5.4)	95 (24.4)	234 (60.2)	28 (7.2)	4 (1.0)	

Discussion

This study evaluated the association of nutritional status with self-reported physical fitness indices in school-aged children (7–13). According to our results, the most physically active were normal-weight children. Quite the opposite, obese children reported lower levels of physical activity than their normal-weight peers. These findings confirmed that the 60 min/day guideline (World Health Organization, 2019) for children was negatively associated with overweight and obesity, which reveals that being physically active was associated with lower BMI, thus providing support for the role of physical activity in the maintenance of body weight and the prevention of obesity. These findings are consistent with results from numerous other studies (Dwyer, Baur, Higgs, & Hardy, 2009; Must & Anderson, 2006; Kelishadi et al., 2007). In addition, a significant negative relationship between physical activity (at least 60 minutes for five or more days a week) and overweight was also noted in a more extensive survey of 34 countries involving 162,305 school-aged participants (Janssen et al., 2005).

In all four nutritional status categories of children, the most frequent response given on physical activity was "at least one hour during five or more days weekly". This result does not match the 35% increase in obese Montenegrin schoolchildren from 2004 to 2015 (Martinovic et al., 2015), even though other contributing factors must be considered because of the multifactorial aetiology of obesity. There are also some reports of a growing prevalence of obesity in schoolchildren despite the high levels of physical activity (Tambalis, Panagiotakos, Kavouras, Papoutsakis, & Sidossis, 2013).

'Furthermore, we cannot exclude the possibility that social desirability led to an overestimation of the reported levels of physical activity; this is in contrast to Germany, where over three quarters of girls and two thirds of boys do not achieve the WHO's recommended levels of physical activity (Finger, Varnaccia, Borrmann, Lange, & Mensink, 2018). As seen in previous research, boys are generally more active than girls (Chung, Skinner, Steiner, & Perrin, 2012; Puyau, Adolph, Vohra, & Butte, 2002), which is concordant with our results. Some studies showed in both genders that physical activity levels decrease with age, especially during adolescence. The decrease is higher among younger girls (9–12 years) and older boys (13–16 years) (Puyau et al., 2002), and it manifests in many contexts, including active transportation, physical education classes and leisure physical activity (Cumming, Standage, Gillison, Dompier, & Malina, 2009; Dumith, Gigante, Domingues, & Kohl, 2011; Erlandson et al., 2011). Considering the age of our examinees, this could be one possible reason for this difference. A few studies also suggest that the mechanism of decline in physical activity among adolescents seems to be associated with age (Sherar, Cumming, Eisenmann, Baxter-Jones, & Malina, 2010). It is believed that biological maturation is a factor that can change the pattern of physical activity in children and adolescents. The early-maturing girls can have a decrease in interest in physical activity practice when they experience the physical changes of adolescence, such as increased fat deposition, breast development and hip enlargement, which may hinder the motor and physiological performance, and consequently reduce disposition for physical activity.

Furthermore, the increasing obligations in daily tasks can facilitate the reduction of physical activity. In contrast, the physical changes that occur in boys, such as a gain in height, body weight, higher proportion of lean mass and the widening of shoulders, are beneficial for participation in physical activity, as they result in a more appropriate physical build for success in many types of physical activity, particularly those that emphasize speed, power and strength (Bacil, Mazzardo Júnior, Rech, Legnani, & de Campos, 2015). R. M. Telford, R. D. Telford, Olive, Cochrane, and Davey (2016) highlighted the role of society as a whole and asked the question "Do we accept the premise that young girls are less physically active than boys as 'normal' or is it because we are failing to provide girls with the same level of opportunity and support to be equally active?" (McCrorie et al., 2020). A greater understanding of the mechanisms underlying this difference has the potential to guide physical activity intervention strategies.

In the present study, children who live in rural areas of Montenegro reported being more physically active during the week when compared with their urban peers. A similar difference in regards to the place of residence was found in Scottish study (McCrorie et al., 2020).

Organized sport is a specific type of physical activity and is typically defined as "organized, usually competitive, and

can be played with a team or as an individual" (Eime, Young, Harvey, Charity, & Payne, 2013). The highest number of children regarding all four categories of nutritional status (over 60%) were not engaged in team or non-team sports either. In contrast, for example, in Australia, organized sport is popular among children, with two thirds of children aged 5–14 reporting participation in the previous 12 months (Active Healthy Kids Australia, Report 2016).

Based on the data of the present study, rural children's attendance in physical education classes was significantly higher than amongst urban children. There is no sufficient information to explain this phenomenon adequately, but numerous other studies have been reporting factors like lack of space and equipment being barriers to physical activity at schools, especially in developed countries (Morton, Atkin, Corder, Suhrcke, & van Sluijs, 2016). Overall, the results obtained suggest that the promotion of physical activity should be emphasized interdisciplinary as a way of prevention of childhood obesity as one of the significant public health challenges in the 21st century.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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