Prevalence of overweight and obesity among Belgrade youth: A study in a representative sample of 9–14-year-old children and adolescents

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Abstract
This study was designed to assess the prevalence of overweight and obesity of urban schoolchildren in Serbia, based on the data collected from the representative sample from schools located in Belgrade, the national capital, as a part of a wider national project. The sample consisted of 11,644 schoolchildren (14% of Belgrade's elementary school population from 9–15 years of age). The body-mass index cut-off points of the International Obesity Task Force were used to identify the prevalence of overweight and obesity. The present study has indicated that the overall prevalence observed in the whole sample was 24.2%, of which 19.2% were overweight, and 5% were obese students. Moreover, a higher prevalence of overweight and obesity has been revealed in boys rather than in girls, in all age groups. These high prevalence trends should be accepted as a warning sign and strategies that promote healthy weight among children and adolescents should be adequately developed and applied.

KEYWORDS: childhood obesity, body mass index, elementary school, sex, gender, Serbia

ANTHROPOLOGICAL NOTEBOOKS 19 (3): 71–80.
ISSN 1408-032X

Introduction

Although obesity in childhood is indicated as a complex disorder, the prevalence of overweight and obese children is continually growing globally (Wang & Lobstein, 2006). This has become a worrying public health concern as overweight and obesity in childhood tracks into adulthood (Yang et al. 2007) and is associated with short- and long-term adverse health outcomes (WHO 2004; Steinberger et al. 2009). Moreover, it affects not only the perception of physical competence but is related to a reduced quality of life, mainly due to functional impairments, including deficits in many daily performed motor tasks (Griffiths et al. 2010; Tsiros et al. 2011). In order to support prevention programs, and partly as an emergency signal, identifying individuals (particularly among school populations) who could be classified as obese has become an international trend, and several obesity prevalence studies have been published recently (Ogden, Carroll, Kit, & Flegal, 2012; Wijnhoven et al. 2013; Wang & Lobstein 2006).

No commonly accepted standard has yet emerged (Starc & Strel 2011); although less sensitive than skin-fold thickness and bioelectrical impedance, the body mass index (BMI; weight/height^2) is one of the most widely applied ones (Cole & Cachera 2002). BMI also has a number of practical advantages over the alternatives, mainly thanks to the ease of assessment and a large pool of global age and gender-specific reference databases, while the commonly recommended BMI percentile cut-offs (e.g. BMI, R-95th percentile) diagnose obesity reasonably well. Although it has been proven that the international reference data proposed by Cole et al. (Cole et al. 2000), could be satisfactorily used in diagnosing obesity, due to the ethnic, social and demographic differences among countries, the collection and formation of nationally based reference data and cut-off have been strongly encouraged (Cole et al. 2000; Starc & Strel 2011).

Regarding children in Serbia, there have some efforts to assess the prevalence of overweight and obesity among them (Pavlović et al. 2001; Nedeljković 2006), but some of these data were determined based on self-reported height and weight, rather old and incomplete data, with a limited number of the subjects followed. As a part of a wider national project, aimed at tracking students' physical fitness during the elementary school, as a first step in the creation of the national database, based on the data collected from the representative sample from schools located in Belgrade, we have designed a study aimed to assess the prevalence of obesity. We expect the results of the current study to prompt further attempts in creating a gender- and age-specific BMI national database, followed by the creation of national BMI cut-off points, and more precise assessment of prevalence of obesity in Serbian schoolchildren.

Method

Sample

The sample consisted of 11,644 schoolchildren (14% of the Belgrade's elementary school population from the third to eighth grade, 9–15 years of age). The detailed structure of the sample is presented in Table 1. The sample was selected by means of proportionate stratified random sampling taking into account the location and the number of students

by age and gender in each school. Schools were randomly selected within each part of the city until the established number of subjects by each part was attained. The selected schools agreed to participate in the study.

Table 1: Sample structure by age and gender

School grade/age	Boys	Girls	Total
3 (9–10 years)	951	1016	1967
4 (10–11 years)	1162	1043	2205
5 (11–12 years)	1054	928	1982
6 (12–13 years)	935	886	1821
7 (13–14 years)	898	894	1792
8 (14–15 years)	1006	871	1877
Total	**6006**	**5638**	**11644**

All measurements in the current research were performed in accordance with ethical standards of the American Psychological Association (American Psychological Association, 2007) and were approved by the institutional review board of the Faculty of Sport and Physical Education, University of Belgrade, Serbia.

Measurement of body mass and its classification

Subjects were barefoot in their shorts and T-shirts. Height was measured with Seca stadiometers to the nearest 0.1 cm and weight with pre-calibrated portable weighting scales Seca (Seca Instruments Ltd., Hamburg, Germany) to the nearest 0.1 kg. The body mass index (BMI) was calculated as body mass weight/height² (kg/m²). The international age- and gender-specific child BMI cut-off points for children developed by the Childhood Obesity Working Group of the International Obesity Task Force were used to define subjects as normal-weight, overweight or obese (Cole et al. 2000). These cut-off points were derived in a large international sample using regression techniques by passing a line through the health-related adult cut-off points at the age of 18. Children with BMI values that corresponded to an adult BMI under 25 were classified as normal-weight, those whose BMI corresponded to an adult BMI between 25 and 30 were considered as overweight, and children with a BMI corresponding to an adult BMI above 30 were categorized as obese. The data were collected in 2011. Participants were evaluated during school physical education classes by physical education teachers specially trained for this type of data collection. Consent was solicited from the participating school boards, and student participation was voluntary.

Statistical analysis

To assess potential gender- and age-specific differences in the prevalence of obesity distribution, Chi square was calculated. To explore trends in overweight and obese boys and girls across the grades (Change in Overweight and Obesity rate with grade for boys

and girls) simple linear regression analysis was performed separately for boys and girls; thereafter, the obtained slopes of the regression lines were compared (level of significance: $p<0.05$). The level of statistical significance was set to $p<0.05$. Data were analysed using SPSS 17.0 software (SPSS Inc. Chicago, IL, U.S.).

Results

The prevalence of overweight (OW), obesity (OB), and overweight and obesity (OW+OB) with respect to gender and grade are presented in Table 2. The overall prevalence, observed in the whole sample was 24.2%, out of which 19.2% were overweight, and 5% were obese students (Table 2).

Table 2: The prevalence of overweight and obesity by school grade and gender

Grade	Boys			Girls			Total		
	N	OW	OB	N	OW	OB	N	OW	OB
3	73.2%	20.2%	6.6%	78.1%	17.6%	4.3%	75.7%	18.9%	5.4%
4	70.5%	23.6%	5.9%	76.7%	17.8%	5.5%	73.4%	20.9%	5.7%
5	71.3%	22.7%	6.1%	76.1%	19.9%	4.0%	73.5%	21.4%	5.1%
6	72.5%	20.9%	6.6%	80.7%	16.7%	2.6%	76.5%	18.8%	4.7%
7	75.7%	19.8%	4.5%	82.0%	15.4%	2.6%	78.9%	17.6%	3.5%
8	76.4%	18.1%	5.5%	79.8%	15.5%	4.7%	78.0%	16.9%	5.1%
Total	**73.1%**	**21.0%**	**5.9%**	**78.8%**	**17.2%**	**4.0%**	**75.9%**	**19.2%**	**5.0%**

The overall prevalence (OW and OB), observed in the whole sample according to gender, was 26.9% in boys, and 21.2% in girls. Observed in all age groups, the overall prevalence of overweight body mass and obesity was higher in boys compared to girls (Table 2).

Although the highest prevalence of overweight was found in the 4th and 5th grades, the distribution across the grades was not statistically significant ($p > 0.05$). The prevalence of obesity was equally distributed across the grades, while the distribution of obesity and overweight was significantly higher ($p<0.01$) in the 4th and 5th grades than in others.

When the prevalence of obesity and overweight was compared within boys across the grades, the highest prevalence of overweight was recorded in the fourth grade (23.6%), while the highest obesity prevalence was recorded in the third and sixth grade (6.6%), although these differences in distribution were not statistically significant ($p>0.05$). Taken together, the highest overweight and obesity rates were recorded among boys in the third, fourth and sixth grades ($p<0.05$). Among girls, the highest prevalence of overweight was recorded in the fifth grade (19.9%), the highest obesity prevalence was recorded in the fourth grade (5.5%), while the highest levels of overweight and obesity among girls were recorded in the fourth and fifth grades ($p<0.05$).

Both regression lines are depicted on Figure 1. The slopes of both trend lines were negative (-0.0095 for boys and -0.0083 for girls) indicating exceptionally small decreases (negative trend) in both genders without statistically significant inter-gender differences ($p<0.05$).

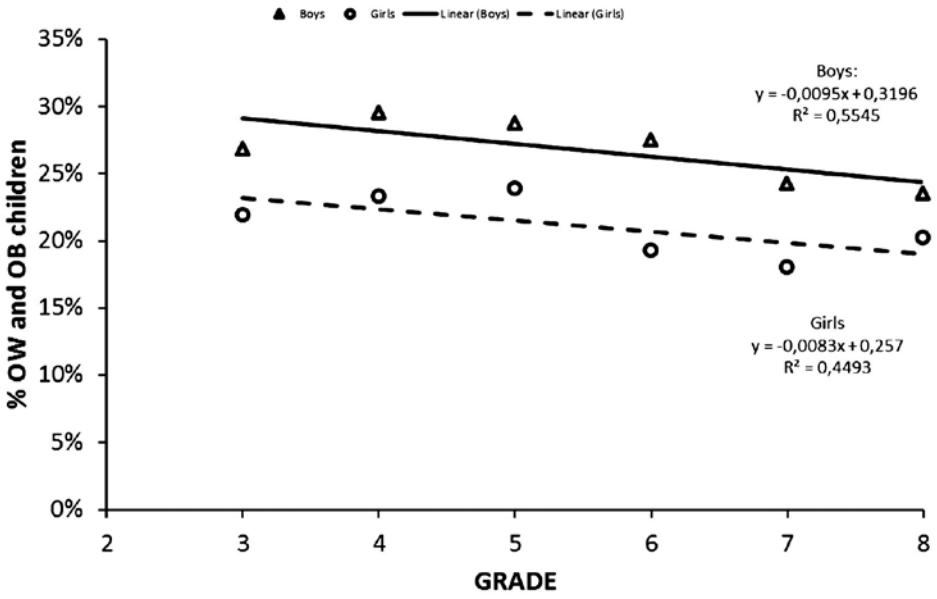

Figure 1: Regression lines (change in overweight and obesity rate with grade for boys and girls)

Discussion

This is the first report documenting the prevalence of overweight and obesity in a representative sample of Belgrade children and adolescents, aged 9 to 14. The overall prevalence observed in the whole sample was 24.2%, of which 19.2% were overweight, and 5% were obese pupils. Looking at the prevalence of childhood overweight and obesity based on measured heights and weights from nationally representative survey data in 21 European countries during the 1990s, Lobstain and Frelut (2003) noted a tendency for a high prevalence of overweight among children from the south-western European countries, and, in contrast, generally lower levels of overweight were found among children in the countries of central and eastern Europe. The authors argued that lower levels of overweight were found among children in the countries of central and eastern Europe whose economies had suffered varying degrees of recession during the period of economic and political transition in the 1990s. According to these data, Serbia (former Yugoslavia) had an obesity and overweight prevalence of 17% in that period and belonged to the group of countries with a low prevalence. However, this data were collected over 10 years ago and, therefore, could not represent the current state.

This study is a part of the wider national project, aimed at following up students' physical fitness across the elementary school time and is the first step in the creation of a national database of which an essential part is to detect the current prevalence overweight and obesity in Serbia. The data collected from the representative sample from schools located in Belgrade in 2011 revealed that the prevalence is 24.2%, indicating an increase

of 6% in prevalence when compared with results obtained 12 years previously. This gives an entirely new picture of the trend of increasing prevalence in Belgrade, and presumably in Serbia as well, since Belgrade is a city with approximately two million citizens and a demographic that resembles that of Serbia as a whole. Therefore, it can be expected that a similar trend will be obtained in the Serbian representative sample (national data collection is in progress).

Regarding the revealed trend that highlights the change in overweight and obesity within boys and girls across the grades, it should be noted that these small decreases in the prevalence rate with grade, although significant, should be taken with caution, while the data presented are obtained in a cross-sectional study, not allowing the drawing of any conclusions about the developmental-related changes, which should be further investigated through the continuous follow-up of the subjects across the grades.

In the ongoing transition period in Serbia, although the economic crisis has not produced shortages and insufficient food, due to reduced financial income, a large number of families have been and still are forced to consume poor quality food. In the diets of both adults and the young, the prevailing food is rich in carbohydrates (bread, biscuits, pasta, etc.), as well as foods with high percentages of fat (pork, burgers, kebabs, etc.). In addition to material deprivation, which is probably one of the reasons for the unhealthy diet that prevails among a large number of children and young people in Belgrade, we assume that the lack of information in a large number of parents concerning a healthy diet could be another factor that has played a part in the increasing prevalence of obesity in children and the young Furthermore, the nutrition of students while they are in school, in the absence of organized and controlled school canteens, is rich in fast food (hamburgers, pizza, snacks, sweets, soft drinks, etc.), which directly results in the increase of obesity in students (Ministarstvo zdravlja RS 2007). This could be supported with results of authors (French et al. 2001; Hills, Andersen & Byrne 2011) who founded that a change in dietary patterns in recent decades, including an increased consumption of soft drinks, candies and junk food, has been implicated in the increase in childhood and adolescent obesity. In addition, in recent decades physical activity patterns in adolescents have changed as a result of increase in time spent watching television and playing computer games (French at al. 2001; Robinson & Godbey 1997). Demographic trends have shown that children and adults in the countries in transition, Serbia included, have already adopted the Western model of urban lifestyle, i.e. a sedentary lifestyle and food rich in fats, meat products and snacks. The trend of reduced physical activity with the age of children in highly developed countries (Caspersen, Pereira & Curran 2000; Trost et al. 2002; Telama & Yang 2000) is also present in Serbia (Radisavljević et al. 2012), and, therefore, the young spend more and more time watching television, sitting in front of a PC, playing computer games and joining various virtual social networks. One of the interesting results of our research regarding the gender of the students indicated that a higher prevalence of overweight students is observed in boys than in girls in all age groups. This finding is in line with those obtained in Portugal (Sardinha et al. 2010), Slovenia (Kovač et al. 2012), and Finland (Vuorela et al. 2011) who recorded the similar trend.

Another important finding of the current study revealed that distribution of obesity and overweight was significantly higher ($p<0.01$) in the 4th and 5th grades than in other grades. The obtained results indicate the potential problem in daily habits in the youngest children in Belgrade, but simultaneously imply that it could be greater in the coming years. The comparison of current findings with those related to childhood obesity reported a decade ago (Lobstain & Frelut, 2003) and registered trends in Slovenia (Leskošek, Strel & Kovač 2010; Kovač, Jurak, Zaletel Kragelj & Leskošek 2013), which, similar to Serbia, has underwent enormous socio-political and economic changes in the last 20 years, indicate alarming forecast. For example, Kovač et al. (2013) found that in every year from 1991 to 2011 the prevalence of overweight and obesity in the capital city of Slovenia increased by 1.7%. Therefore, the prevention of obesity in childhood and effective treatment of overweight children should be essential in Serbia. Prevention may be achieved through a variety of interventions targeting the creation of positive environments, physical activity, and diet. Children are often considered the priority population for intervention strategies, considering that obesity in childhood often follows into adulthood (Starc & Strel 2011; Whitaker, Wright, Pepe, Seidel & Dietz 1997), which further supports the importance of preventing childhood obesity with interventions for children.

These strategies could be initiated at home and in preschool institutions, schools or after-school care services as a natural setting aimed to influence the dietary habits, as well as physical activity manners of preschool and schoolchildren. The successful school-based interventions from countries with similar trends of childhood obesity, educational systems and cultural roots (i.e. Jurak, Kovač & Strel 2012; Starc & Strel 2012) could be implemented.

The potential limits of our study could be the cross-sectional nature of the study, not allowing for drawing any conclusion about the developmental-related changes. In addition, the sample consists of children living in the national capital, which not only has the highest income per capita but also the greatest variety of possibilities for physical activities in comparison to other parts of the country. Nevertheless, due to the careful stratification and relatively large number of subjects in comparison to similar studies (Sardinha et al. 2011; Pavlović et al. 2001; Nedeljković 2006), we believe that our study provides a valid set of data, allowing the comparison of our findings with those of previous studies.

Conclusion

In conclusion, this study was designed to assess the prevalence of obesity of urban schoolchildren in Serbia based on the data collected from the representative sample from schools located in Belgrade, the capital city of Serbia, as a part of a wider national project. The present study has indicated that the overall prevalence observed in the whole sample was 24.2%, of which 19.2% were overweight, and 5% were obese students. Moreover, a higher prevalence of overweight and obesity has been revealed in boys rather than in girls, in all age groups. The highest prevalence of obesity in the youngest age group

of students implies that prevention of obesity in childhood and effective treatment of overweight children should be essential in Serbia. These high prevalence trends should be accepted as a warning sign, and strategies that promote healthy weight among children and adolescents should be adequately developed and applied. However, further research should be performed, including other relevant factors (healthy diet, level of physical activity), within the monitoring of the prevalence of obesity in children in Serbia in order to obtain a more complex picture of this problem and support the development of more efficient strategies for facing with this obviously serious problem.

Acknowledgements

This paper is the result of the projects 'Improving the quality and accessibility of education in modernization processes in Serbia' No 47008 (2011-2014) and 'The effects of physical activity application to locomotor, metabolic, psychosocial and educational status with the population of the Republic of Serbia' No III47015 (2011-2014) financially supported by the Ministry of Education and Science of the Republic of Serbia. The study was also supported in part by a grant from the Serbian Research Council (No 175037 and No 175012).

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Povzetek

Študija je bila zasnovana, da bi ugotovili prevalenco prekomerne prehranjenosti in debelosti učencev iz urbanega okolja Srbije. Podatki so bili zbrani na reprezentativnem vzorcu učencev iz šol v prestolnici kot del nacionalne študije. V vzorec je bilo vključenih 11.644 učencev (14% populacije učencev prestolnice v starosti med 9 in 15 let). Iz dobljenih podatkov smo izračunali indekse telesne mase, za določitev prekomerne prehranjenosti in debelosti pa smo uporabili merila International Obesity Task Force. Rezultati kažejo, da je skupna prevalenca v celotnem vzorcu 24,2%, od tega je 19,2% učencev prekomerno prehranjenih in 5% debelih. Med fanti je večja prevalenca prekomerno prehranjenih in debelih v vseh starostnih skupinah. Visok trend prevalence je treba prepoznati kot opozorilo. Potrebno je razviti in udejanjiti ustrezne strategije za promocijo zdrave telesne teže med otroci in adolescenti.

KLJUČNE BESEDE: debelost pri otrocih, indeks telesne mase, osnovna šola, spol, Srbija

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