OVERWEIGHT AND OBESITY PREVALENCE: A PILOT IMPLEMENTATION OF THE "COSI" METHODOLOGY IN THE REPUBLIC OF SRPSKA

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SUMMARY

Objectives: Childhood obesity has become a worldwide public health concern over the past decade, counting Bosnia and Herzegovina (BiH). The Childhood Obesity Surveillance Initiative (COSI) was established by the World Health Organization (WHO) to address the lack of standardized surveillance data on childhood obesity. However, BiH and its entity, Republic of Srpska (RS), are failing inclusion in such initiative, which hinders efforts to monitor and address the issue. Henceforth, the objective of this nationally funded study was to gather and analyse data on the prevalence of overweight and obesity among primary-school children in RS by implementing the COSI methodology.

Methods: Weight, height, and BMI of first, second, and third grade children (aged 6–8), from 11 schools (N = 2,030) in the RS region was analysed according to the standardized COSI protocol.

Results: The prevalence rates of overall overweight (OW) and obesity (OB) observed were 14.37% (OW 9.09%, OB 5.21%). No gender-related differences were noted (boys 14.36%, girls 14.88%).

Conclusions: These findings highlight a concerning trend of increasing overweight and obesity prevalence with age among primary-school children in the RS.

Key words: body mass index, childhood obesity, elementary school, COSI

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https://doi.org/10.21101/cejph.a8219

INTRODUCTION

Childhood obesity is a complex and multifactorial disease that develops due to lack in maternal nutrition, an unhealthy diet, and physical inactivity (1). The prevalence of childhood obesity has increased worldwide, fuelled by a profound nutritional transition to processed foods and high-calorie diets and an increasingly sedentary lifestyle (2). Obesity and overweight in children are of particular concern because they not only have an immediate impact on a child's physical and mental health and quality of life, but they may also increase the risk of type 2 diabetes, cardiovascular disease, and certain types of cancer later in life (3–5). Global overweight and obesity have increased considerably among children and adolescents aged 5–18 years, from 4% in 1975 to slightly over 18% in 2016 (6). Both boys and girls have seen an increase in obesity; in 2016, 18% of girls and 19% of boys were overweight (6). Even though the prevalence of obesity is lower among children than adults, many countries are experiencing a more rapid increase in childhood obesity compared to adults (6, 7).

The establishment of the World Health Organisation (WHO) European Childhood Obesity Surveillance Initiative (COSI) has resulted in a surveillance system that provides frequent, reliable and accurate data on children's health status via application of standardized record forms: the child record form, the school record form and the family record form (8). Anthropometric data such as assessment of bodyweight, height and body mass index (BMI) are collected from the child record form (8, 9). Additional data on nutritional consumption, physical activity, sedentary behaviour, family history, and educational surroundings are collected in accordance with the school record form and the family record form (8, 9). By establishing standardized surveillance system on childhood obesity, it is possible to compare results obtained from different regions with those of other countries, providing valuable insights into the prevalence and risk factors of the condition, making it an ideal tool for assessing global trends in childhood obesity (10). This information could form the development of effective national health policies and provide a baseline for future research studies and clinical trials aimed at addressing childhood obesity (10).

In the latest, 5th round of COSI data sampling, taking place between 2018 and 2020 (data predominantly collected in 2019), 33 participating countries gathered data on children attending first three grades of primary school (8, 11). During this specific age, most children have passed the early stage of childhood, during which problems with obesity may appear (12). Furthermore, prepubertal identification of problems and monitoring of changes can enable preventive measures to reduce the rate of obesity in the later years of childhood and adolescence due to big differences in sex characteristics once children reach puberty (12).

Published results showed great geographic diversity in average values for height, weight, and BMI (11). On average, the COSI data suggested an increasing north-south gradient, with children of Northern Europe being the tallest, and those of Southern Europe the heaviest (11). Overall, 29% of children were living with overweight (including obesity). Prevalence among boys was 31%, while among girls it was 28% (11). There were still significant disparities between nations, with overweight prevalence ranging from 6% to 43% and obesity prevalence ranging from 1% to 19% (11).

Even though Bosnia and Herzegovina was scheduled to participate in the 5th round of the COSI implementation, data collection was disrupted due to the COVID-19 pandemic; leaving BiH and one of its two entities, Republic of Srpska (RS), without official comparable data about prevalence of overweight and obesity in targeted elementary school-aged children. Moreover, there are serious concerns that the past COVID-19 pandemic may have further exacerbated this problem (13).

Consequently, the aim of this independent, nationally founded research was to independently adopt COSI methodology and to assess the prevalence of overweight and obesity among school-aged children aged 6–8 years in RS entity. As a result, the findings of this study may be compared to COSI data collected from other European nations, offering vital insights into the prevalence and risk factors of childhood obesity in RS.

MATERIALS AND METHODS

Sample

The study included 2,036 children, aged 6–8 years (grades 1st to 3rd), from eleven primary schools in BiH, specifically its RS entity. The minimal planned sample size was determined according to recommendations of the WHO European Office required to implement COSI (14). In order to ensure adequate representation of the country's demography, we adopted a three-stage cluster sampling design: the largest schools from eleven largest municipalities in RS entity were assigned to the study, with the list of public primary schools provided by the national Ministry for Education in RS. Schools provided the final list of participants, randomly allocating students to appropriate grade groups while following equal gender representation. All study procedures were fully disclosed to parents, teachers, and school administrators, and active informed written consent was obtained from the parents or the children's guardians. On the day of the measurement, the youngster verbally agreed to participate in the research. The entire research was in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving research study participants were approved by the Ethics Committee of the Faculty of Sport and Physical Education University of Banja Luka (11/1.160-4/20).

Procedures

As a part of the intended but later cancelled 5th round of data sampling, the WHO COSI representatives provided training for the BiH's field examiners, in accordance with the COSI planned methodology (8). Participating field examiner later provided face-to-face training for physical education (PE) teachers. Trained PE teachers performed anthropometric measurements at participating schools in separated rooms in order to protect the privacy of all participants. During the measurements, all subjects were psycho-physically healthy and participated in the regular PE classes. Data were collected from April to May 2019 and summarized in an Excel sheet for further analysis (Microsoft Excel, USA) using the COSI child record form for anthropometric measurements (8). The child record form was compiled by the examiner to register a child's age in years and months, sex, date and time of measurement, as well as height, weight and BMI. Children's body weight and height were both measured twice and the mean value of the two measurements was used: body height (cm) was measured by a Martin anthropometer with an accuracy of 0.1 cm with the subject standing upright barefoot on a flat surface; body weight (0.1 kg) was measured by a medical weight scale (SECA 877, SECA, Hamburg, Germany), with subjects standing on a scale dressed only in underwear. BMI was calculated as weight (kg) divided by height squared (m2). In order to identify overweight and obese status in children, the WHO cut-offs for school-age children and adolescents were applied (14, 15).

The classification of children's weight status was based on the WHO recommended growth reference for school-aged children and adolescents (8). The WHO cut-offs were used to compute BMI-for-age (BMI/A) Z-scores and to estimate the prevalence of overweight and obesity. According to the WHO growth reference, overweight, obesity and severe obesity are defined as a BMI-for-age value > +1 Z-score, BMI-for-age value > + 2 Z-scores, and BMI-for-age value > +3 Z-scores, respectively, whereas thinness as a BMI-for-age value < −2 Z-score. The estimated prevalence of overweight includes children with obesity, and prevalence of obesity includes severe obesity. Children with biologically implausible (or extreme) values were excluded from the analysis: BMI/A values below −5 or above +5 Z-scores relative to the WHO growth reference median. As International Obesity Task Force (IOTF) cut-off points are widely used in the WHO European Region, prevalence rates were also calculated using these cut-offs (8). Measurements were carried out in the morning hours at the same time of the day (±2 hours) to avoid circadian variance.

Statistical Analysis

All statistical analyses were performed using SPSS Statistics 20.0 statistical package (IBM, Armonk, NY, USA). Descriptive statistics – mean (M) and standard deviation (± SD) are provided for variables – age (years), body weight (cm), body height (kg),

and BMI where frequencies, percentage values (%) and 95% confidence intervals (95% CI) were used to show data distribution within certain categories. All collected data were analysed and presented according to the guidelines provided by the WHO COSI (8, 14). Additionally, a Pearson's chi-squared test was employed to cross tabulate frequency percentages for variables age, sex and prevalence rates of normal weight, obese and overweight. The statistical significance of the calculated chi-square statistic (χ^2) was tested for a certain degree of freedom (df) and at a significance level (p) of 0.05.

RESULTS

The detailed structure of the sample is presented in Table 1. The group of 7-year-olds (812) had the highest participation percentage, with boys accounting for 50.3% and girls accounting for 49.7%. The 8-year-old age group had the second largest presence (706) with boys accounting for 51.3% and girls accounting for 48.7%. The 6-year-olds (518) had the lowest representation, with boys accounting for 52.7% and girls accounting for 47.3%. Overall, boys were more represented, though statistically insignificant, than girls (51.3% vs. 48.7%, $p > 0.05$).

Table 1. *Sample structure represented by age and sex*

	Gender	Age	n	Mean	SD
Height	Boys	6 years	273	120.57	5.06
		7 years	409	128.16	5.67
		8 years	362	134.68	5.99
		Total	1,044	128.43	7.83
	Girls	6 years	245	119.51	5.07
		7 years	403	126.60	5.51
		8 years	344	132.42	6.03
		Total	992	126.87	7.44
	Both	6 years	518	120.07	5.09
		7 years	812	127.39	5.64
		8 years	706	133.58	6.11
		Total	2,036	127.67	7.68
Weight	Boys	6 years	273	24.06	4.67
		7 years	409	28.08	6.20
		8 years	362	32.40	6.85
		Total	1,044	28.59	6.89
	Girls	6 years	245	22.90	4.39
		7 years	403	26.91	5.62
		8 years	344	30.81	6.92
		Total	992	27.27	6.58
	Both	6 years	518	23.51	4.57
		7 years	812	27.50	5.94
		8 years	706	31.63	6.93
		Total	2,036	27.92	6.77
Body mass index	Boys	6 years	273	16.49	2.41
		7 years	409	16.99	2.81
		8 years	362	17.74	2.86
		Total	1,044	17.12	2.77
	Girls	6 years	245	15.98	2.18
		7 years	403	16.68	2.57
		8 years	344	17.41	2.90
		Total	992	16.76	2.66
	Both	6 years	518	16.24	2.32
		7 years	812	16.84	2.70
		8 years	706	17.58	2.89
		Total	2,036	16.95	2.72

The results (Table 2) of the chi-square test showed a statistically significant relationship between age and the incidence of overweight and obesity in both boys and girls: $\chi^2(4, 2036) = 10.37$, $p = 0.035$, contingency coefficient = 0.071. The results showed that frequency of overweight and obesity tends to increase with age (6-year-olds – 12.93%; 7-year-olds – 12.93%; 8-year-olds – 16.86%) in both sexes.

The prevalence rates of normal weight, overweight and obesity observed in the whole sample are presented in Table 3. The lowest overweight rates were reported in 7-year-old boys, and the lowest obesity rates were reported in 6-year-old girls. The highest overweight rates were reported in 8-year-old boys and the highest obesity prevalence was observed in 7-year-old boys. The prevalence of overweight and obesity within boys indicated increasing values with age (6-year-olds – 13.19%; 7-year-olds – 12.71%; 8-year-olds – 17.13%), where highest overweight rates were recorded in 8-year-olds and obesity in 7-year-olds. Similar results were seen within girls across the age groups (6-year-olds – 12.65%; 7-year-olds – 13.15%; 8-year-olds – 16.57%), with highest overweight rates also recorded in age 8, and obesity in age 7. Despite the evident trend of increase in overweight and obesity, the chi-square statistic did not reach the level of statistical significance for 0.05 (boys: $\chi^2(4, 1044) = 8.87$, $p = 0.064$, contingency coefficient = 0.09; girls: $\chi^2(4, 992) = 4.05$, $p = 0.399$, contingency coefficient = 0.06).

The results of the chi-square test showed that there is no significant sex-related difference (6-year-olds: $\chi^2(2, 518) = 0.301$, $p = 0.860$, contingency coefficient = 0.024; 7-year-olds: $\chi^2(2, 812) = 2.197$, $p = 0.333$, contingency coefficient = 0.052; 8-year-olds: $\chi^2(2, 706) = 0.286$, $p = 0.867$, contingency coefficient = 0.020; total: $\chi^2(2, 2036) = 0.120$, $p = 0.942$, contingency coefficient = 0.008), and the occurrence of overweight and obesity is non-sex reliant in all three age groups (boys 14.37%, girls 14.21%).

DISCUSSION

This is the first official report using the WHO COSI procedure to document the prevalence of overweight and obesity among children aged 6–8 years (grades 1st to 3rd) in the RS and BiH. The overall prevalence rate observed in the whole sample was 14.3%, with 9.09% being overweight and 5.21% obese, respectively. Our results show that prevalence rates of overweight and obesity vary across different age groups, with the lowest overweight reported in 7-year-olds, and the highest overweight rate being in 8-year-olds whereas the highest obesity rate was reported in 7-year-olds and the lowest obesity rate was in 8-year-olds. This data showed that with age obesity tends to decline whereas overweight increases. The absence of a statistically significant difference between the sexes observed in our study could be explained by the fact that the examined age groups are characterized by the same physiological responses in terms of nutrition and movement, given that they are not yet at the puberty entering threshold. Indeed, the overall representation of both sexes in our study differed by 2.5%; insufficient to cause statistically relevant assessment bias (16). Henceforth, reasons for results observed in our study are still open for debate and require further analysis.

Similar studies conducted in BiH's other entity yielded somewhat higher but comparable results to counterparts in the RS entity (17, 18). Even though these studies failed to follow strict COSI methodology, the total prevalence of overweight and obesity was 20% and 15.4%, respectively. In the neighbouring countries officially implementing COSI, a large volatility in the findings on

Table 2. *Relationship between overall age and prevalence of overweight and obesity in boys and girls according the WHO definitions*

Age	Normal			Overweight			Obese			Total
	n	%	95% CI	n	%	95% CI	n	%	95% CI	N
6 years	451	87.07	83.9–89.8	39	7.53	5.4–10.1	28	5.40	3.6–7.7	518
7 years	707	87.07	84.6–89.3	62	7.63	5.9–9.7	43	5.30	3.9–7.1	812
8 years	587	83.14	80.2–85.8	84	11.9	9.6–14.5	35	4.96	3.5–6.8	706
Total	1,745	85.71	82.9–88.3	185	9.09	6.9–11.4	106	5.21	3.7–7.2	2,036

Table 3. *Prevalence of overweight and obesity by age and gender according the WHO definitions*

Age	Normal			Overweight			Obese			Total
	n	%	95% CI	n	%	95% CI	n	%	95% CI	N
Boys	894	85.63	83.4–87.7	94	9.00	7.3–10.9	56	5.36	4.1–6.9	1,044
6 years	237	86.81	82.2–90.6	22	8.06	5.1–11.9	14	5.12	2.8–8.5	273
7 years	357	87.29	83.7–90.4	27	6.60	4.4–9.5	25	6.11	4.0–8.9	409
8 years	300	82.87	78.6–86.6	45	12.43	9.2–16.3	17	4.70	2.8–7.4	362
Girls	851	85.79	83.5–87.9	91	9.17	7.5–11.1	50	5.71	3.8–6.6	992
6 years	214	87.35	82.5–91.2	17	6.94	4.1–10.9	14	4.47	3.2–9.4	245
7 years	350	86.85	83.2–90.0	35	8.68	6.1–11.9	18	5.23	2.7–7.0	403
8 years	287	83.43	79.1–87.2	39	11.34	8.2–15.2	18	5.04	3.1–8.1	344

overweight (including obesity) were reported. Serbia has a total prevalence rate of 34.8% (19), Croatia has a rate of 32.4% (20), Slovenia has a rate of 30.2% (21), Hungary has a rate of 26.9% (22), and Montenegro has a rate of 22.9% (23). In neighbouring countries, the general prevalence of overweight and obesity increased with age and, when compared to our data, was higher in boys than in girls. It should be noted that our research includes children from the RS entity only and that the sample indeed might be insufficiently large for a more accurate comparison with peers from the surrounding area.

The WHO COSI protocol provides the most reliable comparative statistics on the prevalence of childhood obesity in Europe. When compared to the results of the 5th round of COSI, the overall prevalence rates of overweight (including obesity) in our study seems to be lower than results reported by other European countries; 29% of 1st to 3rd grade children in the nations collecting COSI data were found to be overweight (including obesity), with overall prevalence being sex impacted and more prevalent in boys (31% vs. 28%), respectively (11).

According to recent data, while the incidence of childhood overweight and obesity is relatively high in European nations, trends have seem to stabilize between 1999 and 2016 (25, 26). However, some Mediterranean countries have seen an increase in the prevalence of overweight and obesity (25). Similar tendency was noted in Estonia, Finland, France, Greece, Italy, Kyrgyzstan, Latvia, Slovenia, Spain, and Sweden (11). In the last wave of COSI data collecting, there were significant disparities between nations, with country-specific prevalence of overweight children ranging from 6% in Tajikistan to 43% in Cyprus (11). The previous round of data collection showed a statistically significant increase in the prevalence of obesity among boys in Georgia and both boys and girls in Sweden. This was followed by a statistically significant decrease in the prevalence of overweight among boys and girls in Malta, among boys in San Marino and girls in Italy, and among boys in San Marino and girls in Malta (11, 27). Possible explanations for these developments include a major effort put in by these countries in recent years to control and prevent childhood obesity.

Several disadvantages must be acknowledged in this study. To begin, the sample only represents the population of RS entity; hence, future research is needed to analyse peers from entire BiH. This was a RS entity national-founded project, with no official WHO support, ultimately failing to collect surplus data on nutritional consumption, physical activity, sedentary behaviour, family history, and educational surroundings of the participants due to non-application of the remaining two forms. Therefore, future study with the WHO support is recommended, allowing implementation of complete COSI methodology. To offer a balanced viewpoint, it is also vital to acknowledge the limitations of the COSI approach. For example, the COSI protocol required participating countries to examine elementary school children grades 1st to 3rd. Due to differences in enrolment policies, some countries analysed children aged 6 to 8, some 7 to 9, and some 6 to 9, causing discrepancy in collected data due to different age groups while preventing adequate data comparison. Indeed, this problem was somehow overcome in the final report where mismatched ages were removed from the final analysis (11). For countries that have included the same ages as we did, both overweight and obesity tended to increase with age, being contradiction to our findings where obesity decreased (11, 24). Furthermore, in our study age and sex differences were analysed providing a more detailed insight in tested age groups whereas original COSI methodology failed to provide such data. Besides, even though COSI's standardized approach is useful for cross-country comparisons, it may not reflect the complexities of regional variations in obesity risk factors as well as age and gender inter-differential ties. Furthermore, COSI methodology has failed to provide any surplus data on relationship between sex specific age and prevalence of overweight and obesity between boys and girls, as done in our study.

Consequently, it is critical to underline that this study might serve as a beginning point for a long overdue, official implementation of the COSI in entire BiH, allowing full scale comparison of anthropometric status of primary school-aged children from 1st to 3rd grade with counterparts in other European nations ensuring sustainability of future measurements of the same generations.

CONCLUSION

The present study found that the overall sample prevalence of overweight and obesity was 14.37%, with 5.21% of the sample being obese and 9.09% of the sample being overweight. These numbers are below the average for all of Europe. The youngsters in our sample tended to exhibit no sex-age differences when compared to the COSI data, with obesity rates decreasing with age while overweight rates continued to rise. The concerning reality is that, for majority of Europe, both overweight and obesity rates rose with age in both sexes. Obesity is a common, serious, and costly chronic disease of adults and children, with an adequate nutritional status surveillance system being critical to reversing the pandemic trend of childhood obesity, particularly in developing national health strategies that provide a healthier environment for children growing up.

Acknowledgments

The authors thank the staff and participants of all elementary schools for their invaluable contributions.

Funding

This research was supported by the Ministry of Science, Technology, Higher Education and the Information Society of the Government of the Republic of Srpska (grant no. 19/6-020/961-15/18) and the University of Banja Luka, Faculty of Physical Education and Sport. Data collection was made possible by permission of the Ministry of Education and Culture of the Government of the Republic of Srpska (07.04/052-3305/19).

Conflicts of Interest

None declared

Data Availability Statement

The data presented in this study is available on request from the corresponding author.

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Received March 13, 2023
Accepted in revised form June 3, 2024