EPIDEMIOLOGY AND ETIOLOGY OF OBESITY IN CHILDREN AND YOUTH OF SARAJEVO CANTON

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Abstract

The aims of the study were to estimate the prevalence of excessive weight in infants and school-age children in Sarajevo Canton, to isolate the main causative agents and to propose a strategy for its efficient prevention. The methods included anthropometry and originally designed questionnaire. Calculated body mass index was classified according to the criteria proposed by Centre for Disease Control and Prevention (CDC). The research included 3608 students from elementary and secondary schools from Sarajevo Canton. Nearly 1/5 of subjects had excessive body weight while 12,49% of students were malnourished. Elementary school lower graders had the highest grade of excessive weight, while the secondary school students exhibited the lowest grade of excessive weight. During school hours, about 42,47% of students were fed on bakery produces and snacks. Non-sparkling, thickened juices are frequently consumed beverages (20,65%), second only to water (51,82%). 58,15% of children consume sweets on daily basis. This is even more prominent among secondary school students (80,85%). Only 1/3 of students practice sports on daily basis, while 8,51% of them rarely engage in sports. Elementary school lower grade students had the lowest level of activity while the secondary school students were the most active. As many as 27,56% students spend two hours or more sitting by the computer or TV set.

The most significant mediators of excessive weight gain are sedentary life-style, frequent consumption of sweets and thickened juices and unsuitable nutrition during school hours. Continuous preventive and therapeutically activities must be undertaken among as wide population as possible.

KEY WORDS: obesity, children, youth

Introduction

Obesity epidemic is one of the most important health problems of modern age. Over the past two decades, obesity prevalence in European countries has tripled. About 50% of adults have excessive weight while 1/3 of European population is obese. Even, 20-30% of European children and adolescents are overweight (1, 2). Statistical data by USA Centre for Disease Control and Prevention (CDC) also testify that the overweight population has tripled over the past two decades. Also, 16% of children and adolescents between 6 and 19 years of age are overweight (3, 4, and 5).

Approximately 60-85% overweight children grow up into obese adults, who lead to earlier and more frequent development of chronic non-infectious diseases: hypertension, early atherosclerosis, Diabetes mellitus Type 2, orthopaedic, endocrine and psycho-social deviations (6, 7). Although hereditary and hormonal factors may be significant in overweight development in children, excessive food consumption and low physical activity are undoubtedly the major causes (8, 9).

Sedentary time spent with TV set and computer coinciding with the consumption of calories-rich food and sweet beverages in the long term leads to an imbalance between energy intake and expenditure. The result of such imbalance is excessive body weight. Body mass index BMI > p 95 is considered obese (5, 10, 11).

An alarming trend of obesity epidemic expansion, and increase in prevalence in young population in particular, represent a problem of major economical and social consequences for every community (12, 13).

European charter on counteracting obesity adopted in 2006 proposes global measures for obesity prevention in all European countries. Precise epidemiological data on the number of obese children and youth and information of their eating habits and activities are prerogative for designing efficient action plan for the prevention of obesity development in each country (14, 15).

Aims of the study

The aims of the study were:
- estimate the prevalence of excessive body weight in children and youth in Sarajevo Canton,
- delineate major causes of this condition and to propose the strategy for its efficient prevention.

Materials and Methods

The study was conducted during 2008 and 2009. It included representative sample of Sarajevo Canton elementary and secondary schools, which were randomly selected. The number of subjects per school class (elementary 1-8 and secondary 1-4) was balanced. The students were requested to fill in a questionnaire. The questionnaire was originally designed for this study and includes questions that pertain to eating habits (frequency, quantity and types of consumed food), consumption of liquids, and physical activity (frequency and intensity). The questionnaire addressed subjects' social status regarding the total number of family members that are sustained from the same source per employed individual. The questionnaires for elementary and secondary schools contained the same questions presented in the form suitable for the participants' age. Anthropometric measurements: body height, body weight, measured in all subjects. The height was measured using vertical stat meter, the values were expressed in centimetres (cm) and rounded at 0,5 cm. Body weight was measured using digital balance, the values were expressed in kilograms (kg) and rounded at 0,5 kg. The study was conducted by 2 teams which included 2 physicians and a certified nurse. The subjects participated in the study on voluntary basis. The data entered into database were anonymous. The statistical data processing was performed according to the age groups: I-IV and V-VIII grades of elementary school and I-IV grade of secondary school.

BMI was used to estimate the nutritional status. It was calculated automatically according to the formula: BMI = body weight (kg) / height $(m)^2$

Nutritional status was derived automatically based on CDC criteria (16):
- BMI < 5 percentile indicates malnourishment.
- BMI < 85 and > 5 percentile indicates normal nutritional status
- BMI > 85 a < 95 indicates higher body weight,
- BMI > 95 percentile indicates obesity.

Results

The total of 3608 students (2329 students from 10 elementary schools and 1270 from 6 secondary schools from Sarajevo Canton) filled in the questionnaire and were examined anthropometrically.

Table 1 presents an overview of the total number of subjects and breakdown according to school age and gender.

Grade School	Total students	M	F
I-IV Elementary	1077	546	531
V-VIII Elementary	1252	680	572
I-IV Secondary	1279	531	748
Schools Total	3608	1757	1851

TABLE 1. Analysis of the examined student group
According to school level, grade and gender

Table 2 presents the data on BMI distribution among the examined students according to the school grade and gender.

Grade School	BMI classification			
	Malnourished (%)	Ideal weight (%)	Excessive weight (%)	Obese (%)
I-IV Elementary	T: 20,86 M: 7,72 F: 13,14	T: 55,26 M: 28,68 F: 26,58	T: 12,28 M: 7,47 F: 4,81	T: 11,58 M: 6,77 F: 4,81
V-VIII Elementary	T: 9,16 M: 4,65 F: 4,51	T: 69,80 M: 37,98 F: 31,82	T: 13,07 M: 7,49 F: 5,58	T: 8,00 M: 3,69 F: 4,31
I-IV Secondary	T: 6,76 M: 1,31 F: 5,45	T: 80,43 M: 34,15 F: 46,28	T: 9,55 M: 5,18 F: 4,37	T: 3,24 M: 1,47 F: 1,77
Schools Total	T: 12,49 M: 4,63 F: 7,86	T: 68,74 M: 33,60 F: 35,14	T: 11,86 M: 6,71 F: 5,15	T: 6,86 M: 1,32 F: 5,54

TABLE 2. BMI classification of students according to the school grade and gender

The quality of nourishment during school hours in the examined students and in various school age groups is presented in Table 3.

Grade School	Home-made sandwich (%)	School provided sandwich (%)	Bakery produces (%)	Snacks (%)	Do not eat at school (%)
I-IV Elementary	30,69	44,63	5,04	17,68	1,98
V-VIII Elementary	16,57	24,62	42,67	10,96	5,27
I-IV Secondary	2,70	41,09	42,01	8,89	5,37
Schools Total	16,65	36,78	29,90	12,57	4,20

TABLE 3. Quality of nourishment during school hours

Table 4 presents distribution of beverages consumption during the day among the student groups.

The frequencies of sweets consumption among students are presented in Table 5.

Grade School	Water (%)	Non-sparkling juice (%)	Milk (%)	Sparkling beverages (%)
I-IV Elementary	50,88	23,19	23,37	2,6
V-VIII Elementary	54,94	21,71	12,45	11,87
I-IV Secondary	49,35	16,77	13,19	20,72
Schools Total	51,82	20,65	16,43	11,05

TABLE 4. Types of beverages consumed during school hours

Grade School	Sweets consumed on daily basis (%)	Sweets consumed rarely or occasionally (%)
I-IV Elementary	30,89	59,11
V-VIII Elementary	64,53	33,47
I-IV Secondary	80,85	19,15
Schools Total	58,15	31,24

TABLE 5. Distribution of sweets consumption frequencies

Table 6 presents the distribution of the degree of physical activity among students that participated in the study.

Grade School	Active on daily basis (%)	Active in sports classes only (%)	Active 2-3 times weekly (%)	Rarely(%)
I-IV Elementary	19,92	39,05	40,36	0,00
V-VIII Elementary	36,42	27,56	24,52	11,50
I-IV Secondary	46,89	29,19	18,08	5,65
Schools Total	31,07	31,93	27,65	8,51

TABLE 6. Distribution of the degree of physical activity among the students

Table 7 presents the distribution of the time that students spend with computer or TV set (higher grades of elementary school and secondary school students).

Grade School	< 1 hour (%)	1-2 hours (%)	2-3 hours (%)	> 3 hours (%)
I-IV Elementary	23,60	36,62	18,51	20,89
V-VIII Elementary	13,81	30,56	27,74	27,96
I-IV Secondary	18,70	33,59	23,12	24,42
Schools Total	31,07	31,93	27,65	8,51

TABLE 7. Distribution of the time spent with computer or TV set

Discussion

This is the first study in the Federation of Bosnia and Herzegovina that presents data on the frequencies of obesity among students of elementary and second-

ary schools in Sarajevo Canton. According to the data on the number of students in elementary and secondary schools at the time of the study provided by Ministry of education and science of Sarajevo Canton the sample of 3608 subjects represents 7% of the total student population of Sarajevo Canton. Balanced distribution of male and female subjects and the numbers of included participants from lower and higher grades of elementary schools and the number of secondary school students make this sample representative of the total student population of Sarajevo Canton. The results of the study show that almost 20% children between 6 and 18 years of age have excessive weight (overweight and obese). Review of 21 study conducted in various European countries indicate that the obesity prevalence is higher in Western and Southern Europe. In the Mediterranean area, the prevalence of childhood obesity reaches 20-40%, while the frequency of obese people in northern countries is lower 10-20% (2). Between 1980 and 1990, the frequency of obesity among children in developed countries has increased two to five times. For example, obesity in boys has increased from 11% to 30% in Canada. The statistical data indicate four times higher frequency of excessive weight in developing countries. In Brazil, for example, the frequency has increased from 4% to 14% (6). Between 1984 and 1994, in Great Britain, the frequencies of overweight children from 4 to 11 years of age has increased from 10,2% to 13,8% for boys and from 5,4% to 9,0% for girls (2, 6). According to NHANES (National Health and Nutrition Examination Survey) study conducted in the United States of America between 1999 and 2002, 31,0% of children and adolescents between 2 and 19 years of age had BMI > p 85, which represents risk group for obesity, while 16,3 % had BMI > p 95 and were obese (17). In our study, excessive weight (BMI 85-95) was equally observed in boys and girls when the total sample is considered. Students with such BMI are at risk of obesity development with BMI > 95. In the total sample, we observed 6,76% students that belong into this category. Although sex ratio was balanced in the group of overweight students, there were four times more girls in the group of obese children (5,45% vs. 1,32 %). In a study conducted in Holland, girls were more obese in all the analyzed periods between 1980 and 2003. The total number of overweight children between 4 and 16 years of age increased considerably from 1980 to 2003 in Holland. In 1980, obesity prevalence was 3,9% in boys and 6,9% in girls. Already, in 1997, the values increased to 9,7% for boys and 13% for girls while the most recent study conducted in 2003 found 14,5% overweight boys and 17,5 % overweight girls (18). Obesity prevalence among our subjects decreases from 11,58% in lower grade elementary school to 3,24% in secondary school children. These results concur with the findings in Dutch study where the highest frequency of obese children was found among elementary school children (11). The finding of 12,49% of malnourished students is curious. There is in increase from secondary school group to lower graders: from 6,76-10,68%. The results of NHANES study conducted from 2003-2006 indicate that 3,3% Americans between 2 and 19 years of age are malnourished (19). The reason behind such finding is not clear but it could include irregular nourishment and absence of regular cooked meal at school for all the students attending the same morning shift. Most of the children eat either school made sandwich (36,78%) or bakery produces (29,90 %). Snacks are mostly consumed by elementary school lower graders (17,68%). A study conducted by Irish and British authors underlines significance of brunch as a source of excessive energy. They also underline the importance of high-quality and low-energy brunch for younger children (5-9 years of age). A brunch may amount to 20% daily caloric intake. In our subjects, excessive body weight was mostly found in younger students. According to the data by British authors from 2005, adolescents consume up to 32% of daily caloric intake in the form of brunch (20). Regarding caloric content, bakery produces that are mostly consumed by our teenagers and adolescents (42,6% and 42,01%) would be compatible with the brunch of British adolescents. Other than water, which is consumed by 61, 85% of students, the most frequently consumed beverages are non-sparkling juices (20,65%). Lower grade students are the most frequent consumers of this beverage (23,19%), which makes almost one quarter of the subjects. If 5-10 years old child consumes 1 litre of such beverage per day, it means that a third or a quarter of daily caloric requirements are taken in the form of sweet beverage. Refreshing drinks supplemented with sugar became everyday habit that is considered beneficial and desirable; in particular when "fruit drinks" are concerned. World Health Organization recommends that sugar supplements in a beverage should not exceed 10 % of daily caloric intake (21). Numerous studies analyze the issue of beverages consumed by children and adolescents. Small children between 2 and 5 years of age that consumed such beverages on daily basis had higher weight gain.

There is a positive correlation between the consumption of fruit drinks and the degree of obesity. Sweetened soda based beverages have low nutritive benefit, however they lead to increased body weight, risk from diabetes, caries and bone fracture. An effort should be made to promote the consumption of water, low-calorie milk and small quantities of 100 % fruit juices. The total energy input from these drinks should not exceed 10% of daily caloric needs (22, 23).

Due to high sugar and fat content sweets are the most caloric foods. As many as 58,15 % of Canton Sarajevo students consume sweets daily. A study conducted by a Mexican team established that a fifth of subjects consume sweets on a daily basis. However, comparing the feeding habits of employed adolescents with those of unemployed adolescents, significantly higher level of sweets and snacks consumption is established in the employed group. Curiously, the highest level of sweets consumption is found in the group of secondary school students (80,85%). This fact may be explained by the extended school hours that are spent in two shifts, while no hot meal is organized. The need for food is immediately satisfied by consuming sweets, which provide subjective feeling of fullness. Also, sweets are consumed quickly, which leaves students with time for other activities during the school break (18, 24). The smallest frequency of overweight students was found among secondary school students. Also, this group is the most frequently engaged in everyday sports activities. Approximately one third of elementary school lower graders consume sweets daily. Also, the highest frequency of obese and overweight students is found in this group (13,86 % total). Almost 20% of German children between 3 and 17 years of age consume sweets on daily basis. Chocolate is consumed by 16% of subjects. With regards to our data, we find the sweets an important energy source. However, they are the most frequently consumed by the group with the highest number of fit children. The reason behind desirable weight among this group of students we find in their frequent engagement in sports, which helps in maintenance of their body weight (25).

Approximately one third of the examined subjects engaged in sports on daily basis, while 8,51% of them reported occasional engagement in sports. Excessive weight was most frequently identified in the group of elementary school lower grade students, which contained the lowest number of students who practiced sports on daily basis (19,92%). The USA reports also quote small frequency of regular sports activities among adolescents (25%). The fact that 14% of adolescents reported no physical activity is alarming (10, 11). A study conducted in Holland reports that only 3-5% of elementary school children living in large cities practice recommended one hour of daily physical activity. (11, 13) A positive correlation between the time spent with TV set and excessive weight is evident (14). Giammattei et al. mention sedentary time spent with TV and the consumption of soda drinks as leading causes of obesity in children between 11 and 13 years of age (31). This group of our schooling children (36,62%) spends one or more hours with TV and computer. About one half of the total examined children spend two or more hours with screen. In developed countries, two hours per day is recommended as upper limit for time spent with screen (26, 27, 28). The data obtained in this study indicate existence of obesity among Sarajevo Canton children and youth. The need for planning and implementation of preventive studies in this population is implied. Preventive measures would include:

- Education on the principle of healthy eating habits in all elementary and secondary schools, primarily in Sarajevo Canton, than in Bosnia and Herzegovina in general. Nutrition should be based on modern nutritional guidelines with regards to the balance among carbohydrates, fats, proteins, vitamins and liquid;
- Implementation of regular physical activity of at least one hour per day, at school as well as in free time;
- To identify subjects with excessive weight (p among 85 and 95) and obese individuals (p>95) and to refer them to the institutions where their condition can be evaluated and treated;
- To engage family medicine teams to monitor nutritional status of school children and youth.

Conclusion

The results of this study indicate that the problem related to excessive weight, which includes overweight and obese children does exist. The main causes of such circumstances are indicated. Major causes of obesity in our country are sedentary lifestyle, frequent consumption of sweets and thickened fruit juices and inadequate nutrition during school hours. Preventive and therapeutically actions must be continuously implemented and should include as wide population as possible. Implementation of such measures in the schooling population is particularly important having in mind that 60% of obese children grow into obese adults with numerous chronic health problems, which lead to suffering from chronic non-infectious diseases: type II diabetes mellitus, chronic heart disease, bronchial asthma, and orthopaedic and psychological problems.

List of Abbreviations

CDC	-	Centre for Disease Control and Prevention
BMI	-	Body mass index
cm	-	centimetre
kg	-	kilogram
NHANES	-	National Health and Nutrition Examination Survey

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