

Prevalence and some risk factors of childhood obesity

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Summary. *Background and aim of the work:* The aim of this study was to establish the prevalence of children obesity, and some potential risk factors responsible for the development of obesity among primary school students. *Methods:* The prevalence of obesity in schoolchildren were measured in 6,444 children attending primary schools on the territory of the city of Novi Sad (the Province of Vojvodina, Republic of Serbia). Some potential risk factors responsible for the development of children obesity were analyzed in the sub-sample consisting of 120 randomly selected pupils and members of their families, from the total study sample. The data were obtained through basic anthropometric measurements and questionnaires. *Results:* Overweight were found in 11.10% of boys and 10.24% of girls and obesity were found in 5.46% of boys and 4.45% of girls. Significant differences were found between obese and normal weight children regarding the analyzed potential risk factors. Differences were found regarding to obesity of fathers ($p=0.050$), and affiliation to the autochthonous families ($p=0.020$), practiced everyday outdoor games ($p=0.044$), and regarding to family diet. *Conclusions:* Calorie surplus diet has been confirmed as the dominant risk factor for the development of obesity in the analyzed children, additional factors being factors related to the family and wider social environment.

Key words: schoolchildren, prevalence, risk factors, obesity

Introduction

Obesity is defined as pathological accumulation of adipose tissue in the organism. It appears always when the energy intake exceeds the energy expenditure over a longer time interval; consequently, the energy excess is deposited in the form of fats in the adipose tissue. The positive energy balance results most frequently from certain habits and overall way of life. The most frequently reported risk factors are environment, heredity, physical inactivity and malnutrition (1-4). The most serious complication of childhood obesity is prolongation into the adulthood associated with severe co-morbidity resulting from it in this life period (5).

Previous studies have shown a high prevalence of obesity in the adult population in Vojvodina (Ser-

bia), whereby the role of the traditional high-energy and fat-loaded diet, characteristic of this province, has been well documented (6-8). However, the knowledge about the incidence and causes of obesity among school-age children as well as about the importance of its possible prevention at the earliest stage possible is insufficient. In view of this, the objective of this study was to establish the prevalence of obesity and potential risk factors responsible for the development of obesity among children attending primary schools on the territory of Novi Sad, the largest town of the Province of Vojvodina, in order to assess the importance of this problem and to work out possibilities of timely prevention at the earliest age with the ultimate goal of promoting population health.

Material and Methods

Subjects

For analyzing prevalence of obesity, measurements were carried out at randomly chosen 10 primary schools in Novi Sad, encompassing 3298 boys and 3146 girls aged from 6 to 15 years. All children attending these schools at that time underwent measurements.

For analyzing potential risk factors of children obesity, a sub-sample of total number of 120 pupils and their families (40 normal weight, 40 overweight and 40 obese children) was made by random choice.

Instruments

The prevalence of obesity in pupils were determined by the following anthropometric measurements: body height and body weight as recommended by the World Health Organization (WHO) (9) and National methodological instructions (10). The Body mass index (BMI) (11) was calculated accordingly and compared with the WHO growth reference data (12). The nutritional status of the children was assessed and the incidences of pre-obesity ($\geq P_{85} < P_{97}$) and obesity ($\geq P_{97}$) were established.

In order to determine potential risk factors in the development of childhood obesity, necessary data were obtained by the questionnaires designed for this research¹, encompassing the questions about the nutritional status in the family, socio-economic conditions in families, physical activity of pupils, and characteristic of family diet.

Nutritional status in the family is determined based on the nutritional status of fathers, mothers, brothers and sisters who live in the same family, and was evaluated according to the recorded data on the body height and body mass of all the family members given by the respondents' parents, which then served as the grounding to calculate BMI values. The nutritional status of the adult family members was assessed on the basis of the WHO criteria (11). In order to obtain data on the socio-economic conditions in families, we analyzed the level of education of mothers and fathers, the employment status of parents,

the total financial income, family integrity, national belonging and affiliation indigenous or migrant families.

In order to obtain accurate data on physical activity among the students analyzed the presence in physical education classes in school, then the frequency and average time of walking during the week in their spare time, frequency and duration of playing outdoors (jogging, ball games), as well and the frequency and duration of the training of a sport if the child is practicing in his spare time.

The determination of the characteristic of family diet was based on family diet history, because this is the way to obtain a relatively precise datum on energetic and nutritional values of daily nutrition per capita. One of the parents wrote down all foodstuff consumed by all the family members expressed in grams for 7 days. These data were then divided by 7 to get data on the average daily intake of the consumed food for all the family members. The obtained values (in grams) were converted by the food content tables (13) into the average daily energy intake (in kcal), proteins (in grams and percents), fats (in grams and percents), and special attention was paid to the intake of goodies, or sweets (in grams), titbits (in grams) and soft refreshing drinks (in grams) by a family member.

Procedure

Whole survey were conducted till the end of school year of 2013/2014. The anthropometric measurements of pupils were performed as a part of the program activities co-financed by the government of the city of Novi Sad, thus the only thing required was to obtain the consent of the schools to measure the children. The measurements were made in the schools included in the research in the morning during the physical education class when the subjects were dressed in t-shirts, shorts and socks.

The data on potential risk factors in the development of obesity in childhood were collected from the randomly selected parents. The questionnaires were explained in detail to the parents at the school meetings, where they gave their consent for the survey.

Ethics

This study has been approved by the Ethical Committee of the Faculty of Medicine, University of Novi Sad.

¹ The original questionnaires are available from the authors

Data analysis

The statistical treatment the multivariate and univariate procedures, namely, multivariate analysis of variance (MANOVA), discriminative analysis, analysis of variance (ANOVA), coefficient of discrimination, Student's t-test, Mahalanobis distance, and cluster analysis.

For the initial hypothesis to be accepted, the critical value $p=0.050$ was used.

The further step undertaken by determining the discrimination coefficient was to single out the characteristics which marked the specificity of groups as well as those to be excluded from further treatment, i.e. the area under observation was reduced. The aim of determination and assessment of the homogeneity of groups and the distance between them (Mahalanobis distance) was to describe the phenomenon being observed in the best possible way.

The distance was the basis for grouping the studied entities (cluster analysis on the distance matrix) and the above mentioned grouping was shown by a dendrogram. Thus, the characteristics, which had been singled out, served as the basis to conclude which groups were similar and which were not.

Results

Prevalence of obesity in schoolchildren

According to the BMI value, it was found that 11.10% of boys and 10.24% of girls were overweight and 5.46% of boys and 4.45% of girls were obese (Table 1).

Family's BMI

Analyzing the BMI in fathers, mothers and siblings as risk factor for children obesity, the statistical treatment of the obtained data showed significant differences only with respect to the weight status of the fathers in group of obese children vs normal weight ones. The t-test indicated that the number of obese fathers in the group the obese children families was significantly higher compared to the normal-weight children families ($p=0.050$). Other differences were not statistically significant.

In order to determine the similarities and differences between three groups the families (according to BMI in family members), the greatest distance (0.65) is observed with respect of the families of normal weight children (Figure 1).

Table 1. Prevalence of overweight and obesity in the examined school children

Age	Boys					Girls				
	Total number of measured boys	Pre-obese		Obese		Total number of measured girls	Pre-obese		Obese	
		P85 - P97		\geq P97			P85 - P97		\geq P97	
	N	%	n	%	N	%	N	%		
6	38	6	15.79	5	13.16	24	3	12.50	4	16.67
7	347	35	10.09	30	8.65	337	44	13.06	29	8.61
8	416	44	10.58	33	7.93	353	35	9.92	17	4.82
9	443	44	9.93	22	4.97	435	45	10.34	18	4.14
10	435	53	12.18	21	4.83	415	37	8.92	18	4.34
11	387	42	10.85	20	5.17	399	36	9.02	17	4.26
12	411	51	12.41	21	5.11	386	47	12.18	13	3.37
13	422	53	12.56	20	4.74	395	44	11.14	9	2.28
14	349	37	10.60	7	2.01	352	27	7.67	14	3.98
15	50	1	2.00	1	2.00	50	4	8.00	1	2.00
Total	3298	366	11.10	180	5.46	3146	322	10.24	140	4.45

Socio-economic characteristics of the family

Analysing socio-economic characteristics of all three groups of the families, statistically significant difference was found only in respect of the family origin ($p=0.020$). The families of overweight children prevailed in the autochthonous families versus the families of normal weight children. Other differences were not statistically significant.

Determining the similarities and differences between the families (according to all socio-economic characteristics of the family) by the distance between the groups, the greatest difference is observed with respect of families of overweight children (0.83) (Figure 2).

Physical activity of children

Analysing physical activity/inactivity, it was found that the normal weight children significantly more often ($p = 0.044$) practiced everyday outdoor games (running, ball game) than the overweight children. Other differences were not statistically significant.

The distance between the analyzed groups, according to all physical activity in all three groups of children, shows that the greatest distance (0.87) is in the group of overweight children (Figure 3).

Diet structure

It was found that in the family diets of obese children, the mean daily energy intake ($p=0.000$), the mean daily intake of proteins (g) ($p=0.000$), the mean daily intake of fats (g) ($p=0.000$), the mean daily intake of sweetened refreshing drinks and juices (g) ($p=0.008$), were significantly higher compared to the families of the normal weight children. Also, the mean daily energy intake and the mean daily intake of fats in the families of overweight children were significantly statistically higher ($p=0.004$) compared to those of normal weight children. Other differences were not found.

In order to determine the similarities and differences between the surveyed families (according to diet structure), the distance between the analyzed groups was made. The greatest distance (16.81) is in the structure of the family diet of obese children (Figure 4).

Discussion

The prevalence of obesity among children and adolescents in Vojvodina has not been sufficiently studied so far. However, according to scarce studies published in our Province, it can be concluded that the preva-

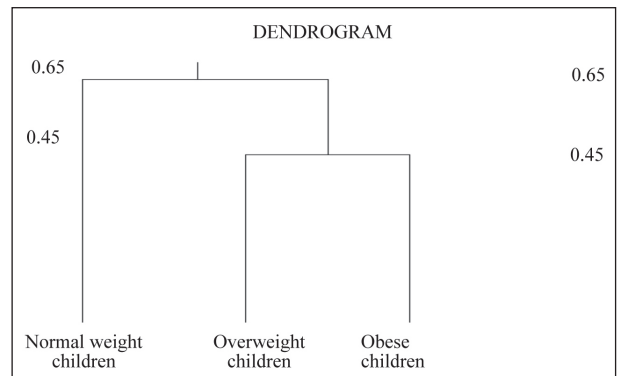


Figure 1. Dendrogram of grouping of the children with respect to the family nutritional status

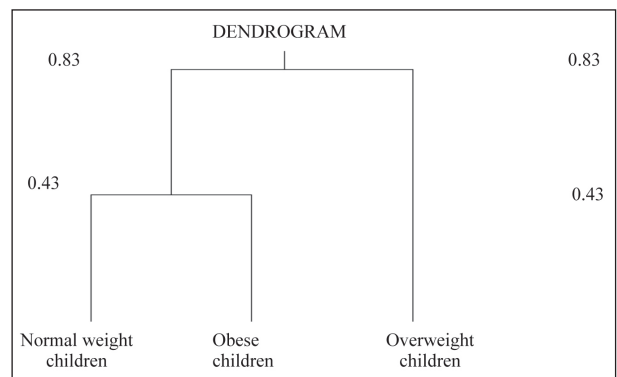


Figure 2. Dendrogram of grouping of the children with respect to the socio-economic status of the family

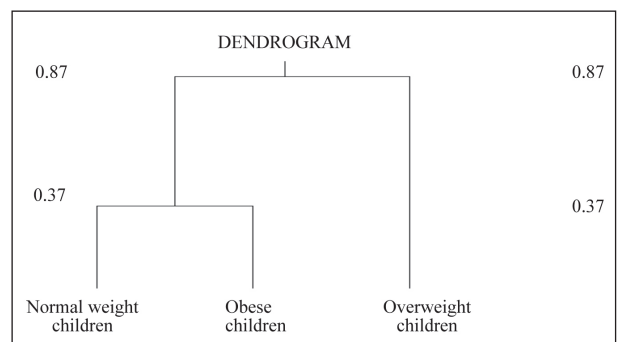


Figure 3. Dendrogram of grouping of the children with respect of physical activity

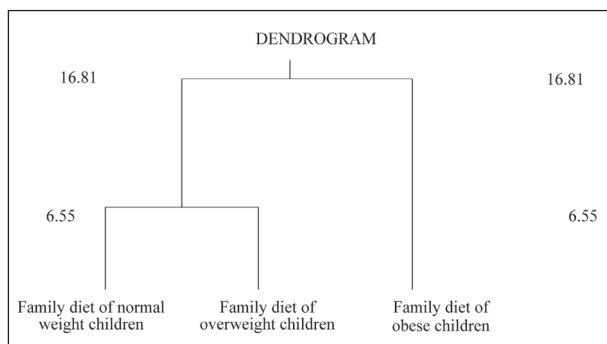


Figure 4. Dendrogram of grouping of the children with respect to the family diet

lence of obesity among school-age children is significant. It should also be noted that the knowledge on epidemiological and risk factors of the obesity in children and adolescents is still insufficient and vague (14-16). In this study, overweight and obesity were found in 16.56% of boys and 14.69% of girls. It means that almost every sixth measured child has an increased BMI in relation to recommendations for age and sex. The obtained data are consistent with similar studies in the world and in our country (14-18).

This study is an attempt to establish the influence of the family and socio-economic factors, physical activity and diet on the development of obesity among schoolchildren.

Many studies have dealt with the importance of heredity (11,19,4), pointing out that there is a genetic predisposition to obesity, and that its progression and further manifestation depend on the effects of other environmental factors, first of all within the family. Indirect proofs of the role of heredity have been obtained by epidemiological studies, showing that obesity is more pronounced among the children of obese parents (20).

In this survey the nutritional status of the family members was defined on the basis of data given by the parents questioned. They were asked to write down the data on body height and body mass of all family members (except measured students from this survey). Such a way of data collection is considered valid (21).

Our study showed a statistically significant correlation only with the obesity of the fathers, while the nutritional status of their mothers and siblings had no statistical significance in cases when the nutritional

status of each family member was analyzed separately. Still, the statistical analysis proved that the nutritional status of the families of overweight and obese children was essentially different from those of normal weight in cases when the nutritional status of all family members was analyzed in totality.

The family environment and certain characteristics of the parents may be a risk factor in respect of some other parameters too. Many previous studies have shown that the particular national affiliation, lower educational level of the one or both parents, poor socio-economic status of the family, and one-parent families, may be a predisposing factor for obesity (22-24). It is known that some ethnic groups, from a certain geographic region, often have quite different living and dietary habits, and even esthetic criteria. This is seen in the choice and supply of foods and/or in the special way of food preparation, which may be a most significant contributing factor, especially in childhood. Also, one should not neglect the fact that obesity is considered as an attribute of health and beauty, especially in childhood. On the other hand, the potential frustrations that may arise from belonging to a special group of people may lead to some disorders in the eating habits resulting in obesity. A lower education level of the parents means also insufficient knowledge of the factors causing obesity. The unemployment of the parents and poor financial situation may be the reason for buying low-quality but high-energy foods, leading also to obesity.

The analysis of our results showed that there was a significant difference between the normal-weight, overweight and obese children regarding the socio-economic status of the family. The highest discrimination was achieved for the variables "allothchtonous families". The variables "national affiliation" and "father's education" were not taken into account in the analysis since the sample was not representative enough for this aspect. Generally, all the socio-economic parameters indicated that the families of overweight children differed essentially from those belonging to the other two groups. The affiliation to the autochthonous families had the highest influence on the development of obesity within these parameters.

Physical activity/inactivity represents a well-known etiological factor in the obesity of adults, where-

as this issue regarding children and adolescents is still questionable. The effect of physical activity/inactivity, i.e. of the sedentary way of life, on the development of excessive body mass and adipose tissue in children is controversial in many studies (25-28). Namely, some studies (29) have reported that obese children are less physically active than the normal-weight ones, while some others (25) have not found any differences in relation to the nutritional status.

Further on, some studies have tried to correlate the children's prolonged TV watching to the incidence of obesity (30). Namely, it has been reported that the prevalence of obesity in children increases on average by 2% for each additional hour of TV viewing, and that this is closely related to the increase in BMI and skin folds (31). Still, the majority of researchers agree that obesity in children, like in adults, is a multi-factorial disorder, and that physical inactivity cannot be considered a separate factor (32,33). Like many foreign studies (34-36), this study has also given some inconsistent results – different conclusions could be drawn depending on the type of physical activity. In relation to a type of activity, statistical significance was confirmed between overweight and normal weight children compared to the frequency of outdoor activities. Analyzing the similarities and differences between students related to overall physical activity, overweight students are different from the others.

The main characteristics of the family diet of obese and normal weight children encompassed by our study confirmed the initial hypothesis on their potential influence on the development of obesity that could lead to some valid conclusions. Normally, the data on the individual diet of each subject would lead to more reliable conclusions, but such data could not be collected. According to obtained data, it was concluded that the diet of the families normal weight and overweight children are different from the families of obese children.

According to the literature data (37-40), the diet of children is characterized by a high consumption of goodies, titbits and sweetened drinks that contribute to the appearance and maintenance of obesity. By analyzing the mean daily intake of sweets (candies, chocolate, cakes, jam, honey, etc.), this study did not give statistically significant differences among the families of the analysed categories of children. The analysis of

mean values obtained for the consumption of various titbits showed that the families of obese children were in lead, but the differences from the others were not statistically significant. Only the consumption of soft refreshing drinks and juices was found to be statistically significant because it was shown that the daily intake of soft refreshing drinks and juices was much higher in the families of obese children than in the families of normal weight children.

Conclusion

A comparison of the structure of the overall family diet for all three categories of schoolchildren showed that the normal weight and overweight children were generally more similar in this respect, and that they differed significantly from obese children.

By analyzing all the investigated potential risk factors in the development of obesity among schoolchildren it can be concluded that the greatest difference between them exists in respect of the family diet (in relation to the distances between the analyzed groups of children, as shown in dendrograms). The other contributing factors are physical inactivity and the factors related to the socio-economic status of the family and a wider social environment, and they are supposed to have less statistically significant influence on the development of childhood obesity than the family eating habits.

Since schoolchildren get some daily meals at school, which are usually neither standardized nor monitored by a nutritionist, their eating habits practiced at school should be also analyzed in order to obtain comprehensive data on the influence of nutrition on the development of childhood obesity.

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