

Family and behavioral factors associated with obesity in school-age children

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The aim of study was to reveal family and behavioral risk factors for the formation of overweight and obesity in the population of school age children.

The whole of 250 randomly selected students aged from 7 to 17 years were investigated in the cross-sectional study. Overweight/obesity was detected in 34% of studied cohort. The statistically reliable factors having high absolute risk ratio for developing obesity in school age children, which were highlighted in the process of study, are as follows: : multi-member family (RR-2,69, P<0,000), mother's secondary education (RR-1,78, P<0,005), father's age >30 years (RR-1,84, P<0,001), formula feeding (RR-1,55, P<0,024), overweight under the age of one year (RR-1,73, P<0,009), maternal overweight (RR-1,45, P<0,037), unbalanced nutrition (RR -1,50, P<0,048), predominantly carbohydrate nutrition (RR-1,7, P<0,016), the low level of physical activity (RR-1,73, P<0,005). In order to develop the preventive programs for struggling against children's obesity, it is deemed expedient to consider the family and behavioral factors having been revealed.

Keywords: Obesity, family, overweight, children

Introduction

Obesity represents the widespread metabolic disease, which is considered to be the global health problem by World Health Organization. The prevalence of overweight/ obesity in the population of children aged from 2 to 19 years has been steadily growing for the last three decades (16, 18). To date, obesity is deemed to be the key factor for deterioration in the quality of life in adults as well as children and adolescents. According to the most recent data, the prevalence of overweight/ obesity in children aged 6-11 years amounts to 7-13%, and at the age of 12-19 it makes up 5-14% (2). Based on the data of WHO overweight and obesity are detected in 41 million children under the age of 5, and this figure reaches 43 million in children aged from 5 to 19 years (25).

The prevention of obesity in children represents the priority objective of public health, since the disease is associated with the prolonged and pernicious complications of health even in adulthood (5, 15, 21).

Obesity is a chronic multi-factorial disease developed by the unified effect of physiological, genetic and environmental factors of broad range. The risk factors comprises the eating disorders, reduction of physical activity, psycho-emotional stress, bad habits, genetic predisposition, endocrine disorders, etc. Obesity is based on the energy misbalance as well as the discrepancy between calorie intake and energy expenditure. Energy misbalance, in its turn, results from the inadequate interaction between genetic and environmental factors (social, nutritive, psychological and physical) (6, 26)

According to scientific researches, the interrelation existing between a child's and parents' body mass index (BMA) is apparent (10, 14). The children, whose parental body mass index ranges within the norm, maintain a healthy lifestyle, regular physical

activities and balanced diet (7,26). The high level of parental body mass index is related to the elevation of children's BMA, hypodynamia, excessive high-fat food intake, media volume and wrong routine, which represent the predictors for obesity (19, 22). The findings of conducted studies are in accord with the standpoint, that parents' BMA reflects their attitude towards health and has the considerable impact on their behavioral habits and weight status (23). The multigenerational family studies conducted on twins, siblings and adopted children demonstrated the impact of parental overweight on the formation of obesity in their offspring and held the viewpoint that the combination of genetic and behavioral factors determines the analogous predisposition to obesity in children and parents (20,22).

The aim of study

The revelation of obesity-related family and behavioral risk factors in the population of school-age children and the assessment of their share

Material and methods

The students of two secondary schools in Tbilisi were investigated in the cross-sectional study. The selection of students was made applying the simple random sampling method. The cohort of 250 randomly selected students aged from 7 to 17 participated in the research.

Screening trial encompassed the determination of anthropometric measurements (body mass, height, shoulder, chest, waist and hip circumferences) and nutritional status. The standard criteria of World Health Organization were utilized (1, 24). The overweight/obesity was confirmed according to the quantitative indicators of body mass index (BMI) and the standard deviation (SDS-standards deviation score) of the population mean of actual BMI. Both methods for the assessment of BMI represent the clinically tested and reliable tools for evaluating children's nutritional status, but the utilization of BMI standard deviation (BMI SDS) is more convenient for the vast clinical trails, as it is simpler and straightforward to assess the produced results (25).

Under the current guidelines, the priority is given to sigma method for conducting the screening as well as in-depth clinical

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trials. The most informational inclusion criteria for the study was considered to be BMI SDS, taking into account the age and gender.

The inclusion criteria for the experimental group were as follows:

The confirmed diagnosis of overweight/ obesity (BMI SDS >1,5)

The age from 7 to 17

The informed consent of a patient

The exclusion criteria from the study were the following:

Secondary obesity (endocrine, iatrogenic, syndromic),

Type 1 (insulin dependent) diabetes

Acute gastrointestinal disease, oncological pathology, mental health disorders

Acute inflammatory disease or exacerbation of chronic pathology.

The children aged from 7 to 17 were included in the control group, considering the correspondence between the body mass and the age, gender and height (BMI SDS ±1).

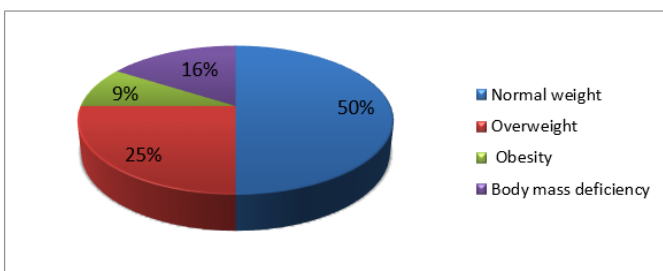
At the next stage, after screening trials, the questionnaire survey of individuals and their parents included in the study was carried out. The investigation was conducted into family members' (parents, sisters, brothers) anthropometric measurements, food ration and its quality characteristics, the degree of physical activity, the length of time spent on TV and computer.

The mathematical analysis of research findings was conducted through using Microsoft Excel 2010 and SPSS/v12 software packages. The parameters (BMI, BMI SDS) were defined using AnthroPlus software calculator. The data are presented by the arithmetic mean (Mean) and standard deviation of Mean (SD). The absolute risk ratio and 95% confidence interval (CI) were defined for the factors associated with obesity. The reliable critical value (P) was considered to be < 0.05

The results of study

The cohort of 250 students aged from 7 to 17, among them 100 girls (40%) and 150 boys (60%) were studied. Overweight/obesity was detected in 84 students (34%) (BMI SDS 1,6±0,3), among them overweight was manifested in 62 children (25%) and obesity - in 22 (9%) children. 84 overweight/obese children were included in the main group. The optimum normal weight was identified in 126 students (50%)(SDS BMI 0,8±2,0), who were involved in the control group. Body mass deficiency (SDS BMI<-2,0 ±1,0) was manifested in 40 cases (16%). The children with body mass deficiency were excluded from the study (Diagram 1).

Nutritional status in studied students



The majority of studied cohort represented Georgian nationality. The mean age of children averaged to 13,9±0,4 year. All of them studied at the secondary school. In terms of sex ratio, boys outnumbered in both main and control groups (Table 1).

Clinical-anamnesic characteristics of studied children

Characteristics	Overweight/ Obesity (n=84)	Normal weight (n=126)	RR	CI	P
Age	14,2 ± 1,8	13,5 ± 2,4			
Girls/boys	30/54 35,7%/64,3%	49/ 77 38,9%/ 61,1%	0,92	0,62-1,32	0,749
Firstborns	56 (66,7%)	69 (54,8%)	1,36	0,93-2,02	0,114
Second- and later-borns	28 (33,3%)	57(45,2%)	0,73	0,49-1,06	0,114
Multi-member family	59(70,2%)	39 (30,9%)	2,69	1,83- 4,02	0,000
Mother's secondary education	21 (25,0%)	12,(9,5%)	1,78	1,20-2,38	0,005
Mother's age >30 year	15 (17,9%)	14 (11,1%)	1,35	0,82-1,95	0,237
Father's age > 30 years	48 (57,1%)	40 (31,7%)	1,84	1,29-2,61	0,001
Birth weight > 4000	14 (16,7%)	11(8,7%)	1,48	0,89-2,09	0,128
Formula feeding	26(31,0%)	21(16, 7%)	1,55	1,06-2,13	0,024
Obesity under one year of age	20(23,8%)	12(9,52%)	1,73	1,15-2,33	0,009

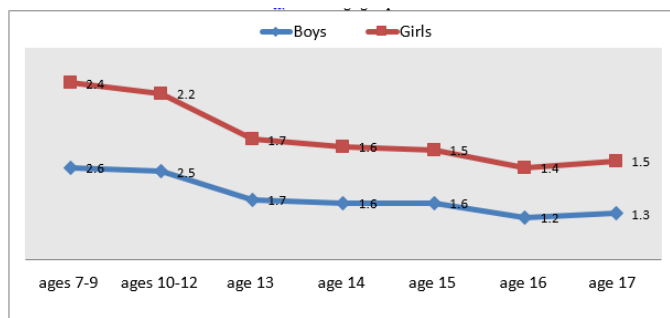
In respect of age and sex ratio, the considerable difference between groups has not been revealed. The majority of children lived in multi-member families (P<0,000). As regards parental age, mothers aged from 18 to 30 years outnumbered in both groups, at the same time, the number of fathers aged over 30 years reliably exceeded in overweight/obese children (P<0,000). The greater bulk of both groups was the firstborns. The majority of children (57,1%) was formula –fed (P<0,024). Overweight was detected in 23,8% of children under the age of one year (P<0,009).

In the process of study all the students were determined anthropometrics (body mass, height, chest, hip, shoulder and waist circumferences) (Table 2)

Anthropometric characteristics in studied students

Anthropometric characteristics	Overweight (n=84)		Normal weight (n=126)	
	Girls (n=30)	Boys (n=54)	Girls (n=49)	Boys (n=77)
Age	14±1,8	14,5±1,7	13,4±2,7	13,5 ± 2,3
Height (cm)	160±9,4	166,5±10,8	156,3±13,7	166,1±10,6
Weight (kg)	70 ± 8,9	75,5±9,8	51,4±9,5	66,4±57,9
BMI kg/m2	27 ± 1,9	27,2±2,1	20,9±1,8	21,6 ± 2,0
SDS BMI	2 ± 0,3	1,6 ± 0,3	1,0 ± 3,1	0,7 ± 0,8
Chest circumference	87,5 ± 9,1	84,9±11,8	78,8 ±9,5	76,1±12,0
Waist circumference	61,2± 6,4	59,4± 8,3	55,2 ±6,7	53,4±8,6
Hip circumference	86,2± 13,5	80,9± 13,2	78,3 ±7,9	75,1±10,4
Shoulder circumference	25,9± 9,0	25,2± 4,1	22,2 ±5,4	22,6±2,9

The quantitative indicators of anthropometric parameters in overweight and obese children exceeded the data in children with normal weight. Practically equal BMI figures were demonstrated in overweight and obese girls and boys. The standard deviation of body mass index (SDS) outnumbered in girls. At the same time, a fair number of gender and age-related peculiarities were highlighted (Diagram2)



The indicator of standard deviation of body mass index (BMI SDS) in different age groups

According to the obtained results, the onset of overweight started in midchildhood in boys as well as girls and became more prevalent at the age from 7 to 12. The mean age of its manifestation averaged to $7,77 \pm 0,61$ years and to a certain extent, the figure in girls ($8,5 \pm 0,4$ years) outnumbered boys ($7,03 \pm 0,5$ years). In frequent cases, BMI SDS exceeded 2, especially in boys. The high figures were mainly identified at the ages of 7-10; they fluctuated within the scopes of 1,4 – 1,7 at the age from 13 to 17, and the increase in weight was again manifested at the age of 17.

The family members (parents, sisters, brothers) were defined anthropometric measurements. The registration of weight and height was made according to the classification of BMI cut-off points. The data was obtained on the basis of mothers' questionnaire survey. The mean of body mass index in mothers of overweight and obese children made up $25,5 \pm 3,7$ kg/m², and in fathers the indicator amounted to $24,0 \pm 10,4$ kg/m². In mothers of children with normal weight BMI averaged to $24,3 \pm 10,4$ kg/m², and in fathers – $25,8 \pm 7,9$ kg/m² (Table 3)

Nutritional status in parents of overweight/obese children

Nutritional status	Overweight (n=84)	Normal weight (n=126)	RR	CI	P
Mothers					
Overweight	32 (38,1%)	29 (23%)	1,50	1,04 - 2,08	0,027
Obesity	11(13,1%)	16 (12,7%)	1.02	0.55-1,61	1.000
The sum total	43(51,2%)	45 (35,7%)	1,45	1,02 - 2,05	0,037
Fathers					
Overweight	37 (44,1%)	49 (38,9%)	1.13	0.79-1.60	0.547
Obesity	14 (16,7%)	32 (25,4%)	0.71	0.41-1.13	0.184
The sum total	51 (60,7%)	81 (64,3%)	0.91	0,64-1,32	0.704

The majority of mothers (51,2%) was detected the gain in weight, among them overweight (BMI – $27,4 \pm 2,3$ kg/m²) was identified in 38,1% and obesity - in 13,1% (BMI – $32,5 \pm 1,5$ kg/m²). As regards fathers, overweight was detected in 44,1% (BMI – $26,6 \pm 1,6$ kg/m²) of them and obesity - in 16,7% (BMI – $34,8 \pm 3,2$ kg/m²). Overweight was revealed in 23% (BMI – $27,1 \pm 1,3$ kg/m²) of mothers of children with normal weight, and 12,7% (BMI- $26,6 \pm 1,6$ kg/m²) of them were detected obesity; 38,9 (BMI- $27,4 \pm 1,4$ kg/m²) of fathers were overweight, and their obesity rate amounted to 25,4% (BMI - $33,6 \pm 2,7$ kg/m²). The parental overweight confirmed the existence of genetic predisposition towards obesity.

BMI was studied in other family members (sister, brothers) as well. In case of sisters, BMI amounted to $20,1 \pm 2,9$ kg/m², overweight was detected in 2 girls, and as regards brothers, the mean BMI averaged to $19,0 \pm 3,8$ kg/m², and only a single case of obesity was identified (BMI- 31 kg/m²)

Apart from anthropometric data, the questionnaire survey encompassed the information about parents' and children's lifestyle. The detailed study was conducted on behavioral habits (nutrition, physical activity, the involve-

ment in sports, media volume).

The evaluation of nutrition was made on the basis of multi-case study of 24-hour menu. The analysis of dietary patterns demonstrated, that children's food intake was unbalanced in the majority of cases of overweight /obese children ($P < 0,048$) and carbohydrates exceeded in daily ration ($P < 0,016$).

When evaluating physical activities, the groups of normal and reduced level of physical activity were singled out. 32 of overweight children (38,1%) were involved in various types of sport, the low level of physical activity was manifested in 60 (71,4%) children. Among children with normal body weight, 56 (44,4%) of participants were engaged in sports, and the decreased physical activity was detected in 64 children (50,8%). The mean length of time spent on watching TV ($3,0 \pm 2$ hr.) and using computer ($2,3 \pm 1,8$ hr.) exceeded 2 hours (Table 4)

Behavioral characteristics in school-age children

Behavioral characteristics	Overweight (n=84)	Normal weight (n=126)	RR	CI	P
Nutrition					
Unbalanced	22(26,2%)	18(14,3%)	1,50	1,00-2,08	0,048
Rare, generous portions	13 (15,5%)	17(13,5%)	1,09	0,63-1,67	0,842
Frequent, small portions	15 (17,9%)	26(20,6%)	0,89	0,53-1,38	0,749
Carbohydrate- rich	18(21,4%)	11(8,7%)	1,7	1,10-2,30	0,016
Protein -rich	8(9,5%)	13(10,3 %)	0,94	0,45-1,59	1,000
Physical activity					
Hypodynamia	60(71,4%)	64(50,8%)	1,73	1,16-2,64	0,005
Non-engagement in sport	52(61,9%)	70(55,6%)	1,17	0,81-1,71	0,441
Screen time					
TV (> 2hr)	21(25%)	24(19,1%)	1,22	0,79-1,75	0,391
Computer (> 2hr)	30(35,7%)	56(44,4%)	0,80	0,54-1,15	0,264

The analysis conducted on the study findings allowed us to single out the statistically reliable family and behavioral risk factors associated with overweight (Table 5)

Family and behavioral risk factors

Risk factors	RR	CI	P
Multi-member family	2,69	1,83 - 4,02	0,000
Mother's secondary education	1,78	1,20-2,38	0,005
Paternal age > 30 years	1,84	1,29-2,61	0,001
Formula feeding	1,55	1,06-2,13	0,024
Overweight under the age of one year	1,73	1,15-2,33	0,009
Maternal overweight/obesity	1,45	1,02-2,05	0,037
Unbalanced nutrition	1,50	1,00-2,08	0,048
Predominantly carbohydrate nutrition	1,7	1,10-2,30	0,016
Low level of physical activity	1,73	1,16-2,64	0,005

The results of study confirmed the standpoint about the link between the genetic and family factors of overweight and obesity developed at children and adolescent ages. The researches of recent years have demonstrated the obvious connection between the paternal BMI, anthropometric data of family members (parents, sisters, brothers) and the obesity of children age (4, 9, 18). The family environ-

ment, unhealthy dietary patterns, low level of physical activity and prolonged screen time condition the formation of the behavior characteristic of obesity (8, 9, 18). The special attention should be focused on the viewpoint implying the existence of specific interactions between parents and children, which encompasses the force - eating of food, the utilization of sweets for the purpose of encouragement and the achievement of favourable behavioral results as well as the elements of indulgence, especially in firstborn children. At the same time, the adynamic lifestyle and decrease in physical activities are typical for urban residents. The absolute majority of children prefers the “sitting” style of life. The prolonged consumption of TV or computer is related to the additional and excessive intake of carbohydrate food (sweets, fizzy drinks), especially in the second half of a day (11,13).

According to the data of a fair number of authors, dietary behavioral problems are revealed in 60% of obese patients, in other cases the disorders are characterized by the latent course and conditioned by the obesity-related comorbid psychic dysfunction. Behavioral disorders and optional eating patterns cause the impairment of a child's skill of self-regulation for nutrition (3, 4). According to Lazzeri G., the habits of meeting nutritional needs, the endurance of starvation and the resistance to force-feeding strengthen the ability to control nutrition, which creates the preconditions for weight reduction (13).

So, our study confirmed that a multi-member family, paternal age >30 years, mother's secondary education, formula feeding, the existence of overweight under the age of one year belong to the key risk- factors for developing overweight/obesity at children age. At the same time, there was singled out the considerable share of parental overweight/obesity (especially in mothers), eating behavioral disorders and low level of physical activity. The children of obese parents are at doubled risk, especially in case of overweight of both parents. Supposedly, the general genetic predisposition, the dietary patterns established in a family as well as the similar behavioral factors create the preconditions and confirm the multi-factorial significance of family environment for developing overweight and obesity at children age. The awareness of advantageous risk factors assumes great importance, on the one hand, to reduce the negative effect on a child's organs, and on the other hand, in terms of developing the family-oriented programs for the prevention of overweight/obesity.

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