Medical Sciences
ISSN: 1308-7312 (NWSAMS)
ID: 2020.15.2.1B0088

Status : Research Article
Received: 07.12.2019
Accepted: 24.04.2020

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DOI	http://dx.doi.org/10.12739/NWSA.2020.15.2.1B0088	
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CHILDHOOD OBESITY: EXAMINING BMI, BODY FAT, FOOD PREFERENCES, AND PHYSICAL ACTIVITY

ABSTRACT

Childhood obesity has become one of the most serious health challenges of today's world. Food preferences, physical activity status, family, and school offerings of the child play an active role in the development of obesity. This study aimed to determine the body composition of children aged six to nine years and to evaluate the possible factors causing obesity such as food consumption and physical activity. The study was conducted in İstanbul, Üsküdar with 371 primary school students and their parents. Separate questionnaires including food consumption, physical activity, sleep, and breastfeeding were applied to students and their families. Of the children, 13.7% (n=51) were overweight and 23.2% (n=86) were obese. Body mass index (BMI) of children was found to have a positive correlation with the body weight of their parents, childbirth weight, and time spent on computer/television whereas it had a negative correlation with sleep duration ($p<0.05$). Body fat percentage was found to be lower in children of high-income families ($p<0.05$). Children found to be overly consuming foods such as wafers, chocolates, and candy. In conclusion, the factors causing obesity in children should be evaluated as a whole, they should be developed for the health improvement, and parents, children, and staff in schools should be trained in this regard.

Keywords: Obesity, BMI, Childhood Obesity, Food Preferences, Anthropometric Measures

1. INTRODUCTION

Nutrition is defined as the adequate and balanced intake of macro and micro-nutrients to the body to ensure the maintenance of life, growth and development, and protection from diseases. Healthy nutrition is one of the most important factor for the optimum growth and development of children. The rapid growth and development of school-age children, in particular, increases their need for different kinds of nutrients. Family structure, socioeconomic status, and environmental factors influence the formation of healthy eating habits [1]. Problems such as wasting, stunting, and obesity may develop in undernourished or overweight children [2]. Obesity is a global problem with an increasing worldwide prevalence that is characterized by excessive accumulation of fat in the body and associated with diabetes, hypertension, cardiovascular disease, skeletal-muscle disorders, and liver diseases [3, 4 and 5]. The prevalence of childhood obesity is increasing worldwide, including in low- and middle-income countries and is one of the leading public health problems [6]. According to data from the Centers for Disease Control

How to Cite:
Yılmaz Akyüz, E. ve Ural, B., (2020). Childhood Obesity: Examining BMI, Body Fat, Food Preferences, and Physical Activity, Medical Sciences (NWSAMS), 15(2):35-44, DOI: 10.12739/NWSA.2020.15.2.1B0088.

and Prevention (CDC), the prevalence of obesity in children between 2 and 19 years of age is 18.5% in the United States and affects about 13.7 million children and adolescents. In this report, the prevalence of obesity is seen to increase with age, from 2 to 19 years [7]. Environmental factors such as increased consumption of fast-food and sweetened beverages, an increase in time spent sitting in front of the TV or computer, and decreased physical activity play an active role in the going up prevalence of obesity in the world, particularly in childhood obesity [8 and 9]. Childhood experiences play a critical role in social, behavioural, and health outcomes throughout life [10].

2. RESEARCH SIGNIFICANCE

One in three children is overweight or obese in the World Health Organization (WHO) European Region. More than 60% of children who are overweight before adolescence are reported to be overweight in early adulthood. Compared to the past four decades, obesity rates have increased in almost all countries in children and adolescents aged 5 to 19 years [11]. Obesity seen between the ages of six to nine, which is known as pre-adolescence, helps to predict health status during adulthood. The rapid increase in body fat percentage starts during the primary school years [12 and 13]. Obesity incidence in children can be reduced through target-based prevention and interventions before adolescence. This study aimed to investigate obesity and risk factors in primary school children and to evaluate their body composition. It was also aimed to determine the food consumption frequency and physical activity status of children and to develop strategies for healthy eating.

3. MATERIAL AND METHODS

3.1. The Study of Sampling

The study was conducted between October and December 2018 with students, who were selected from the 72 primary schools in Üsküdar district of Istanbul by using the stratified sampling technique and who agreed to participate in the study. Students aged six to nine in the selected schools and their families were included in the study.

3.2. Participants

A total of 371 students (175 boys and 196 girls) and their parents participated in the study. Those with a physical or mental disability who were unable to communicate were excluded. Of the students, 72 were six years old, 97 were seven years old, 84 were eight years old, and 118 were nine years old.

3.3. Anthropometric Measurements

The height of the children was measured using a stadiometer without shoes when they were positioned in the Frankfort plane and the results were recorded in centimetres. Hip circumference was measured at the widest point and the waist circumference was measured midway between the lowest rib and the iliac crest using a flexible tape. Upper middle arm circumference was measured using a flexible tape and results were recorded. Bioelectrical impedance analysis (BIA) is a practical, safe, and inexpensive way for measuring body composition in the field [14 and 15]. Fat, muscle, and water mass analysis of the body composition of children was performed using Tanita DC-360 body composition analyser. WHO's reference for five to 19 years was taken as a reference for children's BMI (kg/m^2) and body fat percentage values according to age [16 and 17]. Cut-off values in terms of low fat, excess fat, and obesity in children were accepted as the second, 85th and 95th percentiles, respectively [18].

3.4. Child Nutrition and Activity in the School

The food consumed by the children in the school canteen was recorded through the questionnaire prepared by the researchers for children. Furthermore, the way of transportation to school, the time allocated to physical activity in the school, the nutritional training courses are given in the school, and whether there was a canteen/cafeteria in the school were questioned.

3.5. Parent Socio-Demographic Characteristics, Child Nutrition, and Activity Knowledge, Preferences Questionnaire

The socio-demographic characteristics of the parents and the information about their children (birth weight, duration of breastfeeding, frequency of food consumption, physical activity status, time spent sitting in front of TV/computer, etc.) were questioned using the questionnaire prepared by the researchers for the parents.

3.6. Research Ethics

The study was approved by the Ethics Committee of Hamidiye Non-interventional Clinical Research of University of Health Sciences (No:18/11) and was conducted in accordance with the Helsinki Declaration. Prior to the study, a written consent was obtained from the parents of each child.

4. FINDINGS AND DISCUSSIONS

Of the 371 students included in the study, 47.2% (n=175) were boys and 52.8% (n=196) were girls. The body composition values of the children according to gender are shown in Table 1.

Table 1. Body composition of children by gender

	Girls	Boys
	Mean±Sd.	Mean±Sd
Age (years)	7.70±1.15	7.63±1.08
Height (cm)	129.21±8.88	129.99±8.84
Body Weight (kg)	29.99±9.07	31.16±9.32
BMI (kg/m^2)	17.63±3.44	18.11±3.60
Muscle Mass (kg)	21.44±4.54	22.62±5.0
Body Water (kg)	16.58±3.49	17.55±3.76
Body Water (%)	56.66±5.45	57.31±6.64
Waist Circumference (cm)	60.99±8.6	62.74±10.1
Hip Circumference (cm)	71.4±9.14	71.9±9.30
Upper Middle Arm Circumference (cm)	20.82±3.03	20.74±5.50

According to BMI values, 13.7% (n=51) of the children were overweight and 23.2% (n=86) were obese. When the prevalence of obesity was examined by gender, it was found to be 26.3% in males and 20.4% in females (Table 2). There was no significant difference in the prevalence of obesity by gender (p=0.325). The prevalence of overweight was found to be 16.5% at seven years of age, 15.5% at eight years of age, 13.6% at nine years of age and 15.3% at six years of age whereas the prevalence of obesity was found to be highest at eight years of age (29.2%), followed by nine years of age (28.8%), seven years of age (16.5%), and six years of age (15.3%), respectively. The rate of excess body fat and obesity (40.6%) was higher in boys than in girls (32.6%) (Table3).

Table 2. BMI by gender

BMI	Girls		Boys	
	n	%	n	%
Underweight	10	5.1	4	2.3
Normal	118	60.2	102	58.3
Overweight	28	14.3	23	13.1
Obese	40	20.4	46	26.3
Total	196	100.0	175	100.0

Table 3. Fat percentages by gender

Fat %	Girls		Boys	
	n	%	n	%
Under Fat	24	12.2	12	6.9
Normal	108	55.1	92	52.6
Overfat	24	12.2	31	17.7
Obese	40	20.4	40	22.9
Total	196	100.0	175	100.0

The mean BMI of the mothers and fathers included in the study was 25.38±4.23kg/m^2 and 27.45±3.96kg/m^2, respectively. Data related to BMI values of children are shown in Table 4.

Table 4. BMI and related parameters

BMI	r	p
Birth Weight	0.140**	0.008
Mother's Body Weight	0.281**	0.001
Father's Body Weight	0.232**	0.001
Breastfeeding Time	0.029	0.620
Breastfeeding Time with Supplementary Food	0.045	0.392

Spearman correlation test

Of the children who participated in the study, 17.5% were not breastfed, 68.5% were breastfed for up to six months, and 14.0% were breastfed for up to 12 months. The income status of the parents participating in the study was found to be correlated with the excess body fat and obesity rates in children ($p<0.05$). The body fat percentage was above 95th percentile in 55.6% of children of families with minimum wage income and 18.8% of children of families with very good income. Children of high-income families were found to have low body fat levels (Table 5).

Table 5. The relationship between the household income and the fat percentages of the children

Income		Body Fat Scales					
		Underfat	Normal	Overfat	Obese	Total	P
Low Income	n	0	2	2	5	9	0.040
	%	0.0	22.2	22.2	55.6	100.0	
Minimum Wage	n	12	48	14	18	92	
	%	13.0	52.2	15.2	19.6	100.0	
Above Minimum Wage	n	22	136	29	51	238	
	%	9.2	57.1	12.2	21.4	100.0	
High Income	n	2	14	10	6	32	
	%	6.2	43.8	31.2	18.8	100.0	

Of the children, 43.7% reported that they were doing exercise regularly while 56.3% reported that they were not doing exercise regularly. The majority (22.4%) of children who were doing regular exercise were found to go to a sports club twice a week. Of those who were doing regular exercise, 22.2% were obese and 61.7% were in normal weight. Of those who were not doing regular exercise, 23.9% were obese

and 57.4% were in normal weight. Although the prevalence of obesity was higher in those doing regular exercise compared to those not doing regular exercise, this difference was not statistically significant (p>0.05). There was a strong statistically significant negative correlation between BMI values and sleep times of children (r=-0.176**, p=0.001). It was observed that the BMI values decreased as children's sleep time increased. BMI values of children were found to have a weak positive correlation with computer use time and TV viewing time on weekdays (r=0.104*, p=0.045; r=0.109*, p=0.036). It was found that the BMI values of children increased as the time spent in front of computers and TV. When the children were examined in terms of having breakfast, 83.3% were found to have breakfast regularly whereas 16% did not. Of those who had breakfast regularly, 21.4% were obese and 60.5% had normal weight. Of those who did not have breakfast, 32.3% were obese and 53.2% had normal weight. Although the prevalence of obesity was higher in patients who did not have breakfast compared to those who did, this difference was not statistically significant (p=0.238).

When the ways of transportation of children to school were examined, 60.9% were found to go to school on foot whereas 24.0% by school bus, 13.6% by car, and 1.9% by bus. Physical education lesson hours were found to be two hours/week in 55.8% of schools, whereas it was five hours/week in 36.9% and an hour/week in 7.3%. It was reported that in all schools, activities such as nutrition panels, conferences and seminars were organized during the school year. While 86% of the primary schools in which the study was conducted had a canteen, 14% had no canteen. The most common foods (excluding water) that girls bought from the school canteen were toast (56.1%), ayran (a traditional yoghurt drink) (45.4%), sugar/wafer/biscuit (41.3%), fruit juice (25%), and cake/pastry (24.5%). The most common foods (excluding water) that boys bought from the school canteen were toast (65.7%), ayran (52.6%), sugar/wafer/biscuit (37.1%), fruit juice (34.9%), and flavoured fruit drinks/cold tea (31.4%). Of the children who had a canteen in their schools, 23.5% were obese whereas 21.2% of those who had no canteen in their schools were obese. Although the prevalence of obesity was higher in students who had a canteen in their schools compared to those who did not have a canteen in their schools, this difference was not statistically significant (p>0.05). The majority of the children included in the study consumed fresh fruit (67.7%) every day but consumed fresh vegetables (50.4%) one to three days a week. Of the children, 51.2% consumed milk every day, 60.6% consumed red meat/meatballs and 72.8% white meat/chicken/turkey once to three times a week. When the relationship between the consumption of pre-packaged products with added sugar and body fat percentages of children was examined, body fat percentages of children who consumed salami/sausage/fermented sausage, soft drinks, hamburger/hot dog, and junk food such as chips/popcorn were higher than those who did not consume these products. However, this difference was not statistically significant (p>0.05). The frequency of food consumption of children is shown in Table 6.

Of the children included in the study, 13.7% were found to be overweight and 23.2% were obese. The rate of overweight or obese girls and boys were 34.7% and 39.4%, respectively. Body fat analysis revealed that 32.6% of girls and 40.6% of boys were overweight or obese. The overweight and obesity rate in Turkey is found to be 33% in girls and 40% in boys in the Childhood Obesity Surveillance Initiative (COSI). In the countries included in the surveillance, the prevalence of obesity/overweight has been reported to be higher in boys than girls [19]. In the monitoring of growth in school-age children (6–9

years) research, it has been found that 6.5% of the children in Turkey are obese and 14.3% are overweight [12]. Childhood (7–8 years) Obesity Survey (COSI-TUR, 2013) carried out in Turkey has revealed that the prevalence of obesity and overweight is 21.6% in girls and 23.3% in boys [20]. In a study evaluating national data retrospectively in China, it has been reported that the prevalence of childhood overweight/obesity has increased rapidly and has doubled in the last two decades [21]. The results of this large-scale study were similar to our results, showing that the prevalence of obesity or overweight in childhood is high. Breastfeeding is known to have a protective effect against obesity [22].

Table 6. Food consumption frequency of children

Foods	Everyday		4-6 Days/Week		1-3 Days/Week		None	
	n	%	n	%	n	%	n	%
Fresh Fruit	251	67.7	62	16.7	57	15.4	1	0.3
Fresh Vegetables	78	21	82	22.1	187	50.4	24	6.5
Fresh Juice	33	8.9	31	8.4	162	43.7	145	39.1
100% Ready-Made Fruit Juice	18	4.9	35	9.4	124	33.4	194	52.3
Fruit Juice	33	8.9	36	9.7	140	37.7	162	43.7
Soft Drinks	5	1.3	9	2.4	102	27.5	255	68.7
Yogurt Drink	56	15.1	70	18.9	209	56.3	36	9.7
Milk	190	51.2	58	15.6	90	24.3	33	8.9
Flavored Milk	50	13.5	24	6.5	107	28.8	190	51.2
Cheese	141	38	76	20.5	93	25.1	61	16.4
Yoghurt	124	33.4	103	27.8	107	28.8	37	10
Flavored Yogurt	16	4.3	14	3.8	69	18.6	272	73.3
Milky Desserts	12	3.2	36	9.7	221	59.6	102	27.5
Red Meat, Meatballs	38	10.2	93	25.1	225	60.6	15	4
White Meat, Chicken, Turkey	19	5.1	55	14.8	270	72.8	27	7.3
Fish	10	2.7	35	9.2	184	49.6	132	35.6
Salami, Sausage etc.	21	5.7	34	9.2	184	49.6	132	35.6
Egg	130	35	98	26.4	131	35.3	12	3.2
Legumes	27	7.3	78	21	245	66	21	5.7
Nuts	94	25.3	88	23.7	172	46.4	17	4.6
Bread	207	55.8	70	18.9	78	21	16	4.3
Cereals	93	25.1	121	32.6	155	41.8	2	0.5
Wafers, Chocolate Etc.	49	13.2	71	19.1	219	59	32	8.6
Chips, Popcorn Etc.	14	3.8	29	7.8	208	56.1	120	32.3
Spreadable Chocolate	19	5.1	41	11.1	145	39.1	166	44.7
Biscuits, Cakes, Cookies	27	7.3	74	19.9	232	62.5	38	10.2
Bagels, Pastry, Pita, Pizza	20	5.4	40	10.8	255	68.7	56	15.1
Fried Potatoes	15	4	46	12.4	256	69	54	14.6
Honey, Jam, Marmalade	73	19.7	55	14.8	166	44.7	77	20.8
Hamburger, Hot Dog etc.	12	3.2	15	4	182	49.1	162	43.7

In the present study, 22.5% of those who were breastfed and 26.2% of those who were not breastfed were obese. Furthermore, the examination of body fat percentages of children showed that 20.9% of those who were breastfed and 24.6% of those who were not breastfed had a high body fat percentage. In a study aiming at evaluating the risk factors causing obesity in obese adolescents, BMI values were found to increase with decreasing breastfeeding duration in children [13]. This is more common in children whose parents are obese or overweight and a strong relationship has been reported between them [21]. The prevalence of obesity was found to be 15.7% in children whose both mother and father were obese and this ratio was identified to be two times higher than their peers [23]. In the present study, a strong positive correlation was found between the body-weight of the parents and the BMI of the children.

Socioeconomic status is one of the important factors in access to food, food consumption, and acquiring eating habits. It has been shown that the income level of the family is associated with the prevalence of childhood obesity and the risk of overweight or obesity is higher in children of high-income families [23 and 24]. In the study by CDC, the prevalence of childhood obesity has been reported to be 18.9% in the lowest income group, 19.9% in the middle-income group, and 10.9% in the highest income group [7].

In this study, a negative correlation was observed between the income level of the families and obesity in children. Children of high-income families were found to have a lower body fat percentage, suggesting that this might be related to the increase in participating in sports opportunities as the income level increased. In a study conducted in Mexico, one of the countries with the highest obesity rates, the prevalence of obesity was found to be 23.4% in children aged eight to 12 years. The study showed that parents gave junk food to children as a reward, the out-of-home eating rate was high, the decision on food was left to children, and children consumed too many fast-food foods and sweetened beverages [24]. In a study by Vollmer and Baietto [2017], it was observed that children preferred high-fat and sugary foods when their parents pressured them to eat and when they used food as a reward [25]. Conversely, children preferred healthier foods if parents made healthy food available in the home and explained why healthy foods should be consumed. Similarly, consumption of fast food and sweetened foods was found to be common in children. We believe that fast food and sugary food consumption can be reduced by raising the awareness of families, children, and teachers about nutrition and restricting children's access to unhealthy foods. Children get many eating habits from their families and their environment. Schools are critical places that influence children's food preferences and therefore their nutritional behaviors [26]. Barriers to healthy eating at school are reported as an inconsistent orientation by teachers, inadequate canteen opportunities, and unsafe food environment around the school [27]. In studies involving primary schools, children have been found to buy mostly chocolate, fried potatoes, toast, bagels, milk, ayran, and fruit juice from school canteens [28 and 29]. In the present study, children were found to mostly buy toast, ayran, sugar/wafer/ biscuit and fruit juice from the school canteen, excluding water. Male students were observed to buy food from the school canteen more than female students. This can be considered as one of the factors affecting the higher rates of obesity in boys than girls.

Children like foods and beverages that are high in sugar. However, excessive consumption of foods containing sugar, particularly those with high fructose content, is an important risk factor for the development of obesity and cardiovascular diseases [8]. Foods that have been shown to cause obesity include beverages with high sugar content, biscuits/cakes and chocolate/wafers [30]. In the present study, we found that children consume these foods once to three times a week. Children have been reported to eat very small amounts of fruit and vegetables every day, to consume junk food and sweetened beverages drinks, not to exercise regularly, and to spend too much time in sedentary activities such as watching TV and using electronic devices [11]. The data obtained in our study showed similar results. Current interventions for the prevention of childhood obesity primarily focus on changing nutrition and physical activity habits through school-based policies. Kim et al. [2019] provided 10-week nutritional training to children and showed that healthy eating habits significantly increased in the intervention group at the end of the

training [31]. It has been recommended to train the parents by putting them into the center and to consider and support the child's living spaces as a whole to promote health in early childhood [32].

5. CONCLUSION AND RECOMMENDATIONS

The prevalence of childhood obesity is increasing worldwide and threatens health. The increase in body fat percentage and obesity in childhood increases the risk of obesity in the future and paves the way for many metabolic diseases. This study aimed to determine whether students attending the elementary schools in Üsküdar, Istanbul have obesity, to determine the body composition of these children, to evaluate the factors that may cause obesity, and to create preventive strategies in living spaces. The obesity prevention programs should focus on increasing physical activity, reducing the use of screens (computer/TV), reducing fast food consumption, and promoting healthy eating both at home and school. Furthermore, besides the nutritional training courses given in schools, sustainable and positive changes can be made at home particularly with the training to be provided to parents. Comprehensive intervention programs targeting children, parents, and schools are necessary to promote and protect health.

LIMITATIONS OF THE STUDY

The study was conducted with primary school-aged children in only one region in Turkey.

ACKNOWLEDGEMENTS

The authors would like to thank Üsküdar Municipality and Tarti Medical for their non-financial contribution in conducting the study.

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