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Original Article

Identification of Significant Risk Factors for Obesity Among Children Aged Five to Nine Years: A Cross-Sectional Analysis

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ABSTRACT

Aim: Being overweight or obese are characterized by excess fat accumulation and pose substantial health risks representing significant public health challenges in the 21st century. Overweight or obese children will potentially be overweight or obese adults in the future. Individuals who are obese during childhood are more likely to develop non-communicable chronic diseases at an earlier age compared to those who are not obese. Therefore, this study aimed to investigate the obesity rates and the associated risk factors for obesity of primary school students in one of İzmir's districts.

Materials and Methods: This study focused on primary school students aged five to nine years in the Bayraklı district of the İzmir province. A total of 535 children were initially included in this study. We excluded 128 children who had chronic diseases or were taking medicine associated with obesity or those who did not agree to participate. The dependent variable was obesity and the independent variables were defined by socio-demographic and natal features, physical activities, eating habits, screen time (television and computer usage), family structure and parental weight. We administered a questionnaire to the parents and measured the children's weight and height thus calculating their body mass index. Chi-square analysis, t-test and the Mann-Whitney U test were used for statistical calculations. A probability rate was used for obesity and overweight associated factors.

Results: The mean age was 8±1.1 years for the 407 children. The overweight rate was 12% and the obesity rate was 12%. We detected that gender was not associated with obesity or being overweight (p=0.486). Birth weight (p<0.05), irregular meal times (p=0.007), eating snacks (p=0.027), high monthly income (p=0.026), maternal (p=0.03) and paternal (p<0.05) obesity or being overweight and being an only child (p=0.031) were found to be associated with obesity or being overweight for the child.

Conclusion: The findings of this study revealed elevated frequencies of being overweight or obese among children aged five to nine years in the Bayraklı district, comparable to rates observed in developed nations. High monthly income, being an only child, and parental obesity or being overweight were associated with the children's obesity or being overweight. These results underscore the necessity for education among parents and caregivers regarding healthy and balanced nutrition practices.

Keywords: Pediatric obesity, obesity risk factors, obesity frequency

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Introduction

Being overweight or obese are defined as abnormal or excessive fat storage which poses a risk to health (1). Childhood obesity remains one of the major public health challenges of the 21st century (2). According to the World Health Organization (WHO) European Regional Obesity Report 2022, the prevalence of overweight or obese individuals increases in the 5-9 year old age group, with approximately one in eight children (11.6%) afflicted by obesity and nearly one in three (29.5%) classified as being overweight (including obesity) (3).

The main cause of childhood obesity is the energy imbalance between calories consumed and expended per day. WHO recognizes that the prevalence of childhood obesity is due to societal changes. Changing diets (such as sweetened beverages, junk food and fast food) increase the daily calorie intake, while a sedentary life (prolonged screen time, decreased physical activity) reduces energy expenditure leading children to becoming overweight or obese (1).

Childhood obesity is strongly linked to polygenic factors. While genetic factors play a role in adipocyte variations, research suggests that a healthy home environment can counteract their effects (4-6). Although some studies have found that socio-economic status is related to childhood obesity, this relationship is still controversial (7,8).

Obese children and adolescents suffer from both short-term and long-term health problems. It is known that most of those who are overweight or obese in childhood are also likely to be overweight or obese in adulthood. Childhood-onset overweight and obesity increase the risk of cardiovascular diseases, diabetes, bone-joint diseases (such as osteoarthritis) and some cancers (such as endometrial, breast and colon cancer) in adulthood. The risk for obesity-related chronic diseases was found to be associated with the duration of obesity and age at onset (9). Therefore, this study aimed to evaluate the effects of socio-economic status on childhood obesity and its risk factors.

Materials and Methods

Study Population

The data of this cross-sectional study were collected between November, 2019 and January, 2020. The number of children aged 5-9 going to primary school in the metropolitan central districts of İzmir province was 139,026 (BIMER). The central districts of İzmir were stratified based on their number of students, and their share of the total was calculated. Districts with 10% or more of the student population were included. A multistage sampling method was used in this study. Each district was accepted as a cluster and the district to be sampled was determined using the cluster sampling method. The selection of districts for the sample was conducted using a random numbers table. The Bayraklı district was chosen as the study site, in which 15,546 children aged 5-9 attended 29 primary schools.

This study aimed to achieve a sample size of at least 485 individuals with a 95% confidence level and a 5% margin of error (assuming a design effect of 2). To accommodate potential contingencies, the sample size was determined to be 534, including a 10% reserve.

The socio-economic status of primary schools in the Bayraklı district was determined through consultation with the Bayraklı District Health Directorate. Schools were classified into three socio-economic categories: high, moderate, and low. The total weight of all three layers in Bayraklı's population aged 5-9 was calculated, and the number of samples to be obtained from each socio-economic status was determined based on their respective weights, resulting in 134 individuals (25%) from a high socio-economic status, 187 individuals (35%) from a moderate socio-economic status, and 214 individuals (40%) from a low socio-economic status.

This study was approved by the Dokuz Eylül University Non-invasive Research Ethics Committee (approval no.: 2019/24-37, date: 30.09.2019). And informed consent was obtained from all children and their families for publication.

Statistical Analysis

The schools were visited in order to measure the heights and weights of the children aged 5-9. The parents were administered a 32-question survey, which assessed their children's birth characteristics, duration of breastfeeding, dietary habits, physical activities, screen time, the parents' anthropometric data, monthly income per capita, and details regarding medications regularly used by the child and the presence of any past-chronic diseases. The children's anthropometric measurements were evaluated using Centers for Disease Control and Prevention growth charts. Being overweight or obese were categorized based on body mass index (BMI). Individuals with a BMI falling between the 85th and 94.9th percentiles were classified as being overweight, while those at or above the 95th percentile were categorized as obese (9).

The data obtained in this research were coded into a database created in the Statistical Package for Social

Sciences program and statistical analyses were made. In descriptive statistics, categorical variables were expressed as frequency (n) and percentage (%). The chi-square test was used in the analysis of categorical variables. The Levene test was used for the normal distribution of the data determined by measurement, and data with normal distributions were tested with the t-test, and those data without normal distribution were tested with the Mann-Whitney U test. A p-value <0.05 was accepted as statistical significance.

Results

Of the 407 children participating in this study, 217 (53.3%) were girls and 190 (46.7%) were boys. The socio-demographic characteristics of the children are given in Table I.

When all the children in our study group were examined, the mean duration of breastfeeding was 15.1 (±10.1) months, and the mean age of starting complementary feeding was 6 (±3.2) months. 39.5% of the children had regular meal times while 60.5% of them had irregular meal times. It was determined that 97.5% of the children consumed junk food and 74.9% consumed fast food, and 41.5% did regular sports. The nutritional characteristics of the children participating in this study are given in Table II.

86% of the children participating in this study were term and 14% were preterm. When the birth weights were evaluated according to the weeks at birth, 7.8% were small for gestational age, 80.6% were found to be appropriate for gestational age, and 11.6% were large for gestational age.

Of the children participating in this study, 5.5% (n=22) were underweight, 70.5% (n=287) had normal weight, 12% (n=49) were overweight, and 12% (n=49) were obese.

When examining the relationship between the socio-demographic characteristics and obesity, significant associations were found between the number of siblings and per capita monthly income. Similarly, when investigating the relationship between the birth characteristics and obesity, significant correlations emerged with birth weight and birth weight adjusted for gestational age. Additionally, in the analysis of the relationship between nutritional characteristics and obesity, meal sequence and the consumption of junk food were found to be significantly associated with obesity. Moreover, a significant relationship was observed between high maternal and paternal BMI and obesity in the child (Table III).

In this study, no statistically significant relationships were found between obesity and gender, duration of breastfeeding, transition to complementary feeding, fast-food consumption, regular sports, or screen time.

Table I. The socio-demographic characteristics of the children

	n	**(%)**
Gender	407	
Female	217	53.3
Male	190	46.7
Age (mean ± SD, years)	8±1.1	
Family health insurance	385	
Present	342	88.8
Absent	43	11.2
Consanguineous marriage	396	
Yes	69	17.4
No	327	82.6
Maternal education status	400	
Illiterate	12	3
Literate	12	3
Primary school graduate	124	31
Secondary school graduate	85	21.2
High school graduate	116	29
Graduated from university	51	12.8
Paternal education status	399	
Illiterate	7	1.8
Literate	5	1.3
Primary school graduate	119	29.8
Secondary school graduate	74	18.5
High school graduate	143	35.8
Graduated from university	51	12.8
Per capita monthly income	371	
Low income	66	17.8
Low-moderate income	106	28.6
High-moderate income	96	25.9
High income	103	27.8
Siblings	405	
Present	327	80.7
Absent	78	19.3

SD: Standard deviation

Table II. The nutritional characteristics of the children		
	n	**%**
Duration of breastfeeding mean (SD), months	15.1±10.1	
Age at initiation of complementary feeding, mean (SD), months	6 (±3.2)	
Regular meals	403	
Yes	244	39.5
No	159	60.5
Junk food consumption	406	
Yes	391	96.3
No	15	3.7
Fast-food consumption	407	
Yes	291	74.8
No	98	25.2
SD: Standard deviation		

Table III. Factors associated with obesity			
	Underweight+Normal n (%)	**Overweight+Obese n (%)**	**p value**
Siblings			
Present	257 (83.4)	70 (72.2)	**0.012**
Absent	51 (16.6)	27 (27.8)	
Per capita monthly income			
Low or moderate income	214 (75.1)	54 (62.8)	**0.026**
High income	71 (24.9)	32 (37.2)	
Birth weight (mean, grams)	3,216±585	3,486±567	**<0.05**
Birth weight by week of birth			
SGA	27 (9.2)	3 (3.2)	**0.001**
AGA	241 (82.3)	71 (75.5)	
LGA	25 (8.5)	20 (21.3)	
Regular meals			
Yes	174 (57.0)	70 (71.4)	**0.007**
No	131 (43.0)	28 (28.6)	
Junk food consumption			
Yes	293 (95.1)	98 (100)	**0.027**
No	15 (4.9)	0 (0)	
Maternal BMI	25±4	27±5	**0.03**
Paternal BMI	26±3	28±4	**<0.05**
SGA: Small for gestational age, AGA: Appropriate for gestational age, LGA: Large for gestational age, BMI: Body mass index			

Discussion

Obesity constitutes one of the significant health challenges in the current era. According to WHO data, the prevalence of being overweight or obese among children and adolescents aged 5-19 years increased from 4% in 1975 to 18% in 2016. In European countries, roughly one in five children and adolescents were found to be overweight or obese, while in the United States, one-third

were overweight and one-fifth were obese. In this study, conducted in the İzmir province of Turkey, the prevalences of being overweight or obese were found to be 12% and 12% for each. Compared to the United States, this rate of being overweight or obese appears lower. This could be explained by the different eating habits in Turkey. However, our obesity prevalence exceeds the average of European countries. Notably, European countries were categorized into four regions and our country was placed in the Mediterranean Region, where the obesity prevalence aligns closely with ours (10).

In our study, we observed a higher prevalence of being overweight among girls (13.4%) compared to boys (10.5%), whereas obesity was more prevalent among boys (15.3%) than girls (9.2%). When being overweight and obesity are considered together, the frequency was higher in males (female: 22.6%, male: 25.8%), although no significant difference was found between gender and obesity (p=0.45). Although there are studies with similar results to our study in our country, there are also studies in which the prevalence of obesity in girls is higher than in boys. In the studies conducted by Dündar and Öz (4) on secondary school students in Samsun and by Özilbey and Ergör (11) on first-grade students in İzmir, the prevalence of being overweight and obese in boys was significantly higher than in girls. Conversely, a study by Yuca et al. (12) among children and adolescents aged 6-18 in the Van province of Turkey revealed higher frequencies of being overweight or obese in girls compared to boys. The variation in prevalence across regions could stem from differing societal attitudes toward gender, potentially resulting in unequal opportunities for physical activity among girls in the eastern part of the country. In contrast, boys in the western part may experience higher rates due to prolonged screen time (such as computer and tablet games) and families with low socio-economic status show differences in care between genders.

A study evaluating the 10-year trend of being overweight or obese in Canada noted higher frequencies among boys, attributing this difference to biological factors such as gender-based fat distribution and energy needs, as well as social and cultural reasons such as food choices and body image differences. It has been suggested that gender-based norms may also play a role (13). These findings parallel those observed in our study in the İzmir province, suggesting a higher development level compared to other Turkish provinces.

Breast milk intake and the duration of transition to complementary feeding were not significantly associated with being overweight or obese. However, a significant relationship was observed between meal patterns and being overweight or obese. ESPGHAN recommends that children should eat at least four meals daily, including breakfast. Literature reviews have revealed that children who eat three or fewer meals and skip breakfast are associated with being overweight or obese (4,5,14). This underscores the importance of both meal frequency and content in relation to being overweight or obese.

Another nutrition-related factor is the consumption of junk food and fast food (p=0.065), with a significant relationship found between the consumption of junk food and being overweight or obese (p=0.027). Various studies have reported that the consumption of obesogenic foods such as sugary drinks, processed foods, fast food, and confectionery increases the rates of being overweight or obese. In one study, it was determined that fast food consumption led to being overweight or obese, and the educational status of the mothers of children who consumed fast food was lower than that of other children (15). However, in our study, no significant relationship was observed between fast food consumption and being overweight or obese. This may be attributed to the fact that the dietary choices for those children in the primary school age group are primarily influenced by their parents and the sale of fast food products in school canteens and the surrounding areas may be restricted due to obesity prevention programs in schools.

In our study, socio-economic status was assessed by investigating the parents' education levels, their monthly income per capita and the occupation of the person who provided the household income. Our initial hypothesis was that quality food and sports activities are expensive, it would be easier for families with a high socio-economic levels to access healthy food and sports activities; therefore, being overweight or obese would be less common in this group. However, contrary to our hypothesis, we found no significant relationship between parental education levels (mother: p=0.22, father: p=0.99) and the occupation of the primary income provider (p=0.66) and being overweight or obese. Notably, a significant association was observed between high monthly income per capita and being overweight or obese (p=0.026).

When reviewing the existing literature, most studies concluded that a low socio-economic level was associated with being overweight or obese (16,17), although some put forward the opposite view (7,18). Furthermore, an increase in maternal education levels were found to be

inversely proportional to both the child and the mother being overweight or obese (19). When other studies were examined in detail, low socio-economic status in developed countries tended to be associated with being overweight or obese, while the opposite held true in underdeveloped or developing countries. However, in our country, it appears that the accessibility of sugary foods often consumed as fast food and snacks, is higher among individuals with higher monthly income per capita. Additionally, the persistent belief that overweight children are healthier, which is prevalent in our country, leads families with high socio-economic status to offer their children calorie-dense foods and larger portions, potentially contributing to higher rates of being overweight or obese in this group.

In our study, both maternal (p=0.03) and paternal (p<0.05) BMI values were found to be associated with being overweight or obese. At the same time, no significant relationship was observed between the presence of consanguinity between the parents and being overweight or obese (p=0.92). While some have found only maternal BMI to be associated with the child's being overweight or obese (20), some studies have found the significance of both parents on being overweight or obese (7). The lifestyles and dietary habits of parents determine the child's lifestyle with the BMI of the parents influencing the child's BMI trajectory in parallel.

In our study, a significant relationship was observed between the presence of siblings and being overweight or obese (p=0.012). Reviewing the literature, there are studies suggesting that being an only child increases the risk of obesity (21,22). For instance, one study examining the effects of the one-child policy on obesity in the People's Republic of China found that children without siblings had higher BMI values (23). Moreover, the educational status of the mother (p=0.001) and father (p=0.015) and the monthly income per capita (p=0.015) in families with one child were found to be higher. These findings suggest that families with many children may have a lower socio-economic status than those families with one child; this may show that they can not meet their children's daily energy requirements according to their age, and therefore, the children are weaker.

Conclusion

This cross-sectional study aimed to investigate the prevalence of being overweight or obese among healthy children aged 5-9 years in the Central Districts of İzmir Metropolitan Province and to identify potential risk factors.

Study Limitations

The limitation of this study was the difficulty of finding a causal relationship with variables such as dietary habits, physical activity, and screen time due to the cross-sectional design of the study. This study showed both similar and different results when compared with the obesity risk factors in the literature. The general conclusion is that socio-economic status and the parents' knowledge of nutrition affect childhood obesity. For this reason, regular and balanced nutrition education is necessary for both the parents and their children for every socio-economic status.

Ethics

Ethics Committee Approval: This study was approved by the Dokuz Eylül University Non-invasive Research Ethics Committee (approval no.: 2019/24-37, date: 30.09.2019).

Informed Consent: Informed consent was obtained from all children and their families for publication.

Authorship Contributions

Surgical and Medical Practices: E.T.T.K., Concept: E.T.T.K., O.T.İ., A.A., T.G., Design: E.T.T.K., O.T.İ., A.A., T.G., Data Collection and/or Processing: E.T.T.K., Analysis and/or Interpretation: E.T.T.K., O.T.İ., A.A., T.G., Literature Search: E.T.T.K., Writing: E.T.T.K.

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