RESEARCH / ARAŞTIRMA
DOI: 10.26650/IUITFD.1392706
İst Tıp Fak Derg 2024 / J Ist Faculty Med 2024

ASSESSMENT OF INDIVIDUAL, BEHAVIORAL, AND ENVIRONMENTAL FACTORS INFLUENCING OVERWEIGHT/ OBESITY DEVELOPMENT IN CHILDREN AGED 10–14 YEARS*

10-14 YAŞ ARALIĞINDAKİ ÇOCUKLARDA FAZLA KİLO/OBEZİTE GELİŞİMİNİ ETKİLEYEN BİREYSEL, DAVRANIŞSAL VE ÇEVRESEL FAKTÖRLERİN DEĞERLENDİRİLMESİ

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Cite this article as: Karamelikli E, Gül H. Assessment of individual, behavioral, and environmental factors influencing overweight/ obesity development in children aged 10–14 years. J Ist Faculty Med 2024;87(2):153-164. doi: 10.26650/IUITFD.1392706

ABSTRACT

Objective: Childhood obesity has emerged as a pressing global public health issue. This study aims to examine the influence of individual, behavioral, and environmental factors on student body mass index (BMI), thereby contributing to a deeper understanding of the multifaceted determinants of obesity among children.

Material and Method: This study employed a cross-sectional survey using a structured questionnaire to collect sociodemographic, physical activity, and dietary behavior data of students. In addition, the study administered a school information form to evaluate the physical condition of school buildings and quality of school canteen services.

Result: Among the students, 24% and 13% were in the overweight and obese categories, respectively. Mean student age was 12.41±1.13 years. The mean ages of students with obesity were significantly lower than those of students who were underweight or had normal weight. The distribution of student BMI according to obesity status among family members was statistically highly significant. Among students with obesity, the families of 30.1% were obese, whereas this percentage was 8.9% in families of students without obesity. The relationship between gender, age, family history of obesity, time spent watching TV,

ÖZET

Amaç: Çocukluk çağı obezitesi önemli bir küresel halk sağlığı sorunu haline gelmiştir. Bu çalışma, öğrencilerin vücut kitle indeksi (VKİ) düzeylerini etkileyen çeşitli bireysel, davranışsal ve çevresel faktörlerin etkisini incelemeyi amaçlamaktadır. Bu şekilde, çocuklardaki obezitenin çok yönlü belirleyicilerinin daha derinlemesine anlaşılmasına katkıda bulunmayı hedeflemektedir.

Gereç ve Yöntem: Kesitsel tipteki bu çalışmada, öğrencilerin sosyo-demografik, fiziksel aktivite ve beslenme davranışları hakkında bilgi sağlayan yapılandırılmış bir anket formu, okulların fiziki durumunu ve okul kantinlerini değerlendirmek için de okul bilgi formu uygulanarak veriler toplanmıştır.

Bulgular: Çalışmadaki öğrencilerde fazla kilolu oranı %24, obezite oranı ise %13 saptanmıştır. Ortalama yaş, tüm öğrenciler için 12,41±1,13 olarak belirlendi. Obez öğrencilerin yaş ortalamaları, zayıf/normal kilolu öğrencilerinkinden önemli ölçüde daha düşüktü. Öğrencilerin VKİ'lerinin aile bireyleri arasındaki obezite durumuna göre dağılımı istatistiksel olarak ileri derecede anlamlı bulunmuştur. Obez öğrencilerin %30,1'inin aileleri obezdi, bu oran obez olmayan öğrencilerin ailelerinde %8,9'du. Cinsiyet, yaş, ailede obezite öyküsü, TV seyrederek geçirilen zaman, fiziksel aktivite süresi, kantinden alışveriş yapmak sıklığı ile VKİ dağılımı arasındaki ilişki anlamlıydı. Zayıf/normal kilolu grupta,

* Bu araştırma "Karabük ilindeki ortaöğretim öğrencilerinin obezojenik çevre yönünden değerlendirilmesi" adlı doktora tezinden üretilmiştir. Doç. Dr. Hülya Gül, İstanbul Üniversitesi Sağlık Bilimleri Enstitüsü'ne bağlı Halk Sağlığı doktora programında yürütülen tezin danışmanıydı. *This research was produced from the doctoral thesis titled "Evaluation of secondary school students in Karabük province in terms of obesogenic environment." Assoc. Prof. Dr. Hülya Gül was the advisor of this thesis, carried out in the public health doctoral program affiliated with Istanbul University Institute of Health Sciences.*

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Submitted/Başvuru: 18.11.2023 • **Revision Requested/Revizyon Talebi:** 18.12.2023 •
Last Revision Received/Son Revizyon: 01.03.2024 • **Accepted/Kabul:** 04.03.2024 • **Published Online/Online Yayın:** 25.03.2024

physical activity duration, canteen shopping frequency, and BMI distributions was significant. Mean distance between school and home was longer in the underweight/normal weight group than the other two groups. However, this difference did not reach statistical significance (p>0.05).

Conclusion: Addressing childhood obesity requires a holistic approach encompassing various interventions targeting individual behaviors, environmental influences, and societal norms. By promoting physical activity, regulating food environments, and providing education on healthy diets, we can work together to combat the epidemic of childhood obesity, and promote the health and wellbeing of future generations.

Keywords: Childhood obesity, overweight, public health, school, primary health care

okul ile ev arasındaki ortalama mesafe diğer iki gruptan daha yüksekti. Ancak bu fark istatistiksel olarak anlamlı değildi (p>0,05).

Sonuç: Çocukluk obezitesi ile başa çıkmak için bütünsel bir yaklaşım gereklidir ki bu, bireysel davranışları, çevresel etkileri ve toplumsal normları hedef alan çeşitli müdahaleleri içermelidir. Fiziksel aktiviteyi teşvik ederek, besin ortamlarını düzenleyerek ve sağlıklı beslenme konusunda eğitim vererek, çocukluk obezitesi salgınıyla mücadele edebilir ve böylelikle gelecek nesillerin sağlığını ve refahını artırabiliriz.

Anahtar Kelimeler: Çocukluk çağı obezitesi, fazla kilololuk, halk sağlığı, okul, birinci basamak sağlık hizmeti

INTRODUCTION

Obesity has become a severe health issue worldwide, a root cause of many life-threatening diseases in high-income countries. However, overweight and obesity have become a burgeoning crisis in low and middle-income countries, especially in urban environments. The global prevalence of obesity has increased nearly threefold between 1975 and 2016 (1).

Although increased childhood obesity has hereditary, metabolic, and hormonal causes (polygenic obesity), the most consequential reason for increased childhood obesity is high-calorie food intake. However, physicians should not overlook the existence of genetic and hormonal effects on weight gain, though such cases are limited (2). A rapid increase in obesity rates worldwide cannot be explained only by genetics, albeit a significant risk factor. It requires analysis of different environmental, behavioral, and social dimensions of obesity employing innovative methodologies. Researchers have discovered correlations between unhealthy eating, sedentary lifestyles, and obesity from an environmental perspective. Most researchers believe that "genetics loads the gun, but the environment pulls the trigger" (3, 4). Although individual decisions have little impact on human health, many microenvironments (home, school, restaurant, etc.) can directly influence behavioral choices (5). The availability of calorie-rich foods at home, family budgets, and routine meals can affect obesity in children. Children can affect the food environment at home over time, but the environment around the home can significantly influence them (3). Children tend to eat foods that are proportional to what is served. For example, having fruits and vegetables at home can lead to increased consumption in teenagers. Additionally, easily accessible unhealthy foods and drinks cheaper than healthy food items are among the most critical factors for obesity (6).

An increase in screen time reduces the frequency of outdoor activities, leading to weight gain and obesity in children (7). The widespread advertising in media also enhances the consumption of junk food (3). A study of preschool and early adolescence children in Framingham showed that long-term TV viewing caused excessive body fat compared to low-level activity or a high-fat diet (8).

The school is another microenvironment affecting obesity, because children and adolescents spend one-third of the day at school. Therefore, schools provide critical microenvironments for developing diet and exercise habits until adulthood (9, 10).

In recent years, various concerns have been raised about the obesogenic nature of the school environment, including increased competition in food and beverage sales and reduced opportunities for physical activity during the school day (11). International literature suggests that when food is available for sale within a school, and the sale of food is a revenue stream, the food for sale is likely to be less healthy (3). Opportunities of physical activity for students include walking to and from school, physical education classes, and activities during break. However, rapid urban sprawl, road network discontinuity, increased road traffic, steep slopes, and longer distances from the school have reduced the opportunity to walk, and many children use different modes of transportation to reach schools (12, 13). According to the Centers for Disease Control and Prevention, the proportion of students living ≤800 m to school decreased from 90% in 1969 to 31% in 2008 (12). The possibility of walking to school increases if the distance is <800 m (5).

A rapid increase in childhood obesity rates leads to severe social and economic consequences, including an increase in health complications, increased cost of healthcare services, and a decrease in economic growth. In addition, it can reduce child participation in educational and physical activities (14).

Therefore, childhood obesity is seen as a priority public health issue due to its short- and long-term adverse effects

(15). Without proper preventive measures, the detrimental impacts of obesity will reduce individual health and quality of life and overburden the health system and economy. Therefore, more empirical studies must find the links between environmental factors and the prevalence of obesity among children. In this context, this study was conducted to determine the prevalence of overweight and obesity in students and identify the risk factors for obesity.

MATERIALS and METHODS

The study was conducted using a descriptive design.

Population and sampling

This study utilized a cross-sectional field survey technique, collecting data between April 2019 and February 2020, after obtaining necessary approvals from the "National Education Directorates of Karabük and Safranbolu" and Non-Interventional Clinical Research Ethics Committee (Date: 10.03.2019, No: 3/12).

In cluster sampling, samples are carefully chosen from homogeneous subgroups, considering their proportional size and statistical power within the population. For instance, in 2019, Karabük and Safranbolu had 47 middle schools with 9,780 students. The sample size was calculated with a 99% confidence interval and a 5% margin of error using OpenEpi software, resulting in a minimum sample size of 622. The research was conducted in 14/47 randomly selected schools in the region, employing a cluster sampling method. The student sample was chosen systematically using a systematic random process, and the study was completed with 907 students.

Data collection and evaluation

A survey form based on relevant literature and student self-reporting was prepared to assess factors influencing obesity. The questionnaire form included questions about sociodemographic information, eating habits, screen time, and physical activity. The assessment forms were developed utilizing the "Audit Form for School Canteens' Food Offerings and Hygiene Standards of Food Establishments in Educational Institutions," prepared by the "Workplace Health and Safety Unit of the Ministry of National Education Support Services Directorate," aimed at assessing the school environment and opportunities for physical activity. With the assumption that students need to gain full knowledge of legal regulations and the physical and environmental facilities of the school, the evaluation of the physical and environmental conditions of the school and canteen was not included in the student survey. The researcher conducted the evaluation of schools and canteens personally with the school administration's permission.

The researchers measured the heights (in cm) and weights (in kg) of the students who answered the surveys, using the same instruments for everyone. Student heights and weights were measured after removing shoes and outerwear.IBM SPSS statistical software, version 28 (IBM, SPSS Corp., Armonk, NY, USA) and Microsoft Office Excel programs were used for statistical analysis. The cutoff values for obesity were interpreted according to reference z-score values of body mass index (BMI) for age and gender provided by the World Health Organization (WHO) for BMI categories. For data analysis, the chi-square (χ^2) test was used to compare the descriptive characteristics of the students and the categorical features related to their eating habits. Normality tests were conducted using histogram graphs and skewness or kurtosis values. The values of kurtosis and skewness are considered normally distributed when they are between −2.0 and +2.0 (16). analysis of variance (ANOVA) test was used for multiple comparisons that showed normal distribution. $P<0.05$ was considered statistically significant.

RESULTS

According to the analysis, 54.6% of the participants were female, and 45.4% were male students. The average age of the students participating was 12.41±1.13 years. The age distribution was determined to be very close according to gender. The comparison of age distribution of students according to their BMI categories was conducted using one-way ANOVA. Descriptive analyses revealed that 62.62% (n=568) of the students were underweight/normal, 24.15% (n=219) were overweight, and 13.23% (n=120) were obese. Examination of the boxplot graphs indicated the absence of outlier values in the dataset and normality of data distribution across all independent variable categories, as evidenced by kurtosis and skewness ranging from −1 to +1. Levene's test confirmed the homogeneity of group variances (p=0.264). The analysis results indicated a statistically significant difference among the groups, with an observed *F*-statistic of 5.564 and a p-value of 0.004. Effect size (η^2) was 0.12, indicating a moderate effect. Following Bonferroni's *post hoc* analysis, the significance level of 0.05 was adjusted by dividing it with the number of comparisons (0.05/3=0.0166), resulting in a new adjusted significance level of 0.0166. Consequently, mean age was significantly lower for students with obesity than students who were underweight or had normal weight (p=0.004). *Post hoc* analysis did not reveal statistically significant differences among the age averages of other group comparisons (Table 1).

The findings indicated that 13% of the students examined were classified as obese and 24% were identified as overweight. The prevalence of obesity was higher among males (17.7%) than females (9.96%), and this difference was statistically significant. Furthermore, 20.5% of the students reported having family members with obesity, and the prevalence of obesity was notably elevated in student who had family members with obesity (Table 2).

Table 1: Relationship between distribution of mean age and BMI

	n	Min–Max (Year)	Yaş ortalaması±SD (Year)	Skewness	Kurtosis
Age distribution	907	9.83–15.33	12.41±1.13	0.002	−0.980
BMI			**Yaş ortalaması±SD (Year)**	**F**	**p**
Normal/underweight	568		12.49±1.14	5.564**	0.004*
Overweight	219		12.37±1.06		
Obese	120		12.12±1.16		

*: p<0.05, F = One-way ANOVA, **: Bonferroni = normal/underweight >obese, SD: Standard deviation, P: Probability, BMI: Body Mass Index

Table 2: BMI status according to demographic characteristics of students

		Normal/ underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	p
Gender	Girl	328 (66.3)	119 (24)	48 (9.7)	495 (100)	0.002
	Boy	240 (58.3)	100 (24.3)	72 (17.5)	412 (100)	
Child order	1.	238 (61.3)	95 (24.5)	55 (14.2)	383 (100)	0.901
	2.	217 (63.1)	82 (23.8)	45 (13.1)	345 (100)	
	3.	85 (65.4)	29 (22.3)	16 (12.3)	130 (100)	
	4.	22 (62.9)	11 (31.4)	2 (20.0)	36 (100)	
	5.	6 (60.0)	2 (20.0)	2 (20.0)	10 (100)	
Grades	Weak	24 (60.0)	15 (37.5)	1 (2.5)	40 (100)	0.091
	Moderate	53 (68.8)	14 (18.2)	10 (13.0)	77 (100)	
	Good	167 (62.8)	57 (21.4)	42 (15.8)	266 (100)	
	Very Good	324 (61.8)	133 (25.4)	67 (12.8)	524 (100)	
Mother's education level	Illiterate	7 (53.8)	4 (30.8)	2 (15.4)	13 (100)	0.831
	Primary school	150 (62.2)	55 (22.8)	36 (14.9)	241 (100)	
	Secondary school	127 (63.8)	46 (23.1)	26 (13.1)	199 (100)	
	High School	175 (59.9)	79 (27.1)	38 (13.0)	292 (100)	
	University	109 (67.3)	35 (21.6)	18 (11.1)	162 (100)	
Father's education level	Illiterate	2 (40.0)	2 (40.0)	1 (20.0)	5 (100)	0.402
	Primary school	86 (68.3)	25 (19.8)	15 (11.9)	126 (100)	
	Secondary school	107 (65.2)	33 (20.1)	24 (14.6)	164 (100)	
	High School	199 (57.8)	99 (28.8)	46 (13.4)	344 (100)	
	University	174 (64.9)	60 (22.4)	34 (12.7)	268 (100)	
Chronic illness in the student	No	543 (62.3)	213 (24.4)	116 (12.8)	872 (100)	0.542
	Yes	25 (71.4)	6 (17.1)	4 (11.4)	35 (100)	
Presence of obese individuals in the family	No	479 (66.4)	178 (24.7)	64 (8.9)	721 (100)	0.000
	Yes	89 (47.8)	41 (22.0)	56 (30.1)	186 (100)	
Number of meals	2 meals	96 (57.1)	46 (27.4)	26 (15.5)	168 (100)	0.421
	3 meals	370 (62.0)	144 (24.1)	83 (13.9)	597 (100)	
	4 meals	73 (68.2)	24 (22.4)	10 (9.3)	107 (100)	
	≥5 meals	30 (83.3)	5 (14.3)	1 (2.9)	36 (100)	

Table 2: Continue

		Normal/ underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	p
Regularly consumed main meals at home	Breakfast is eaten	410 (63.5)	154 (23.8)	82 (12.7)	646 (100)	0.660
	Breakfast is not eaten	158 (60.5)	65 (24.9)	38 (14.6)	261 (100)	
	Lunch is eaten	227 (63.9)	93 (26.2)	35 (9.9)	355 (100)	0.045
	Lunch is not eaten	341 (61.8)	126 (22.8)	85 (15.4)	552 (100)	
	Dinner is eaten	557 (62.5)	216 (24.2)	118 (13.2)	891 (100)	0.860
	Dinner is not eaten	11 (68.8)	3 (18.8)	2 (12.5)	16 (100)	
Duration of exercise	<1 h per week	113 (54.3)	55 (26.4)	40 (19.2)	208 (100)	0.009
	1–2 h per week	204 (62.0)	80 (24.3)	45 (13.7)	329 (100)	
	3–4 h per week	134 (64.1)	53 (25.4)	22 (10.5)	209 (100)	
	>4 h per week	117 (72.7)	31 (19.3)	13 (8.1)	161 (100)	
Duration of sleep	< 6 h	3 (50.0)	2 (33.3)	1 (16.7)	6 (100)	0.963
	6–8 h	275 (62.2)	108 (24.4)	59 (13.3)	442 (100)	
	9–10 h	268 (63.5)	99 (23.5)	55 (13.0)	442 (100)	
	>10 h	22 (59.5)	7 (27.0)	5 (13.5)	37 (100)	
Time spent watching TV	0–30 min.	89 (69.5)	26 (20.3)	13 (10.2)	128 (100)	0.034
	31–60 min.	139 (70.2)	44 (22.2)	15 (7.6)	198 (100)	
	61–120 min.	180 (57.5)	84 (26.8)	49 (15.7)	313 (100)	
	121–180 min.	84 (61.8)	32 (23.5)	20 (14.7)	136 (100)	
	181–240 min.	31 (67.4)	10 (21.7)	5 (10.9)	46 (100)	
	>240 min.	45 (52.3)	23 (26.7)	18 (20.9)	86 (100)	
Computer playtime	0–30 min.	124 (70.1)	40 (22.6)	13 (7.3)	177 (100)	0.220
	31–60 min.	89 (15.7)	28 (12.8)	19 (15.8)	136 (100)	
	61–120 min.	131 (60.1)	51 (23.4)	36 (16.5)	218 (100)	
	121–180 min.	87 (58.4)	38 (25.5)	24 (16.1)	149 (100)	
	181–240 min.	56 (63.6)	21 (23.9)	11 (12.5)	88 (100)	
	>240 min.	81 (58.3)	41 (29.5)	17 (12.2)	139 (100)	
Type of school-home transportation	Walking	322 (63.6)	116 (23.0)	66 (13.1)	506 (100)	0.624
	Vehicle	246 (61.0)	103 (25.6)	54 (13.4)	401 (100)	

P: Probability, BMI: Body Mass Index

There was no significant link between student sleep time and BMI distribution. However, duration of physical activity showed meaningful correlation to BMI distribution. Obesity rate was 19.2% for students with <1 h of exercise per week, compared with 8.1% for those >4 h per week. Table 2 shows a significant correlation between student TV viewing times and BMI. Watching TV for >240 min daily correlated with higher obesity and overweight rates.

The study did not find a significant link between student mode of transportation to school and BMI distribution. For students who walked, walking distance was 58–1,500 m. Although students with obesity had a slightly shorter average walking length, this difference was insignificant (Table 3).

The types of beverages and foods most students purchased from the school canteen are shown in Figure 1. Bagels, pastries (70.2%), wafers (60.1%), and toast (49.8%) were the most purchased foods, whereas nuts (3%) and soup varieties (1.3%) were the least purchased foods from the school canteen.

Examination of BMI distributions according to food and beverage preference showed that overweight and obe-

sity rates were higher in students who consumed raw meatballs, ice cream, chicken doner, meatball sandwiches, schnitzel soup, from the canteen than those who did not. This difference was found to be statistically significant (Table 4).

Although the difference between purchasing frequency from the school canteen and BMI distribution was not statistically significant, noteworthy patterns emerged. Students who never made purchases had 0.0% obesity rate, whereas the rate was 22% for consistent buyers (Table 5).

Table 3: Relationship between the distance between home and school (in m) and BMI

	n	Min–Max (Meter)	$\bar{x}$±SD (Meter)	Skewness	Kurtosis
Distance between home and school	504	58–1500	516±268	0.695	0.360
BMI	**n**		**$\bar{x}$±SD (Meter)**	**F**	**p**
Normal/Underweight	322		519.14±272.41	0.244	0.783
Overweight	116		520.07±257.68		
Obese	66		494.64±267.05		

F = One-way ANOVA, SD: Standard deviation, n: Number, p: Probability, BMI: Body Mass Index

Table 4: BMI distribution according to student food and beverage preferences from the school canteen or external sources

	Purchase Status	Normal/underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	p
Bagel-pastry	Not purchasing	171 (63.3)	62 (23)	37 (13.7)	270 (100)	0.851
	Purchasing	397 (62.3)	157 (24.6)	83 (13)	637 (100)	
Waffle-chocolate varieties	Not purchasing	219 (60.5)	94 (26)	49 (13.5)	362 (100)	0.527
	Purchasing	349 (64)	125 (22.9)	71 (13)	545 (100)	
Ice cream	Not purchasing	525 (63.9)	192 (23.4)	105 (12.8)	822 (100)	0.047
	Purchasing	43 (50.6)	27 (31.8)	15 (17.6)	85 (100)	
Chewing gum	Not purchasing	461 (63)	178 (24.3)	93 (12.7)	732 (100)	0.646
	Purchasing	107 (61.1)	41 (23.4)	27 (15.4)	175 (100)	
Biscuit-cake	Not purchasing	350 (59.4)	155 (26.3)	84 (14.3)	589 (100)	0.024
	Purchasing	218 (68.6)	64 (20.1)	36 (11.3)	318 (100)	
Chips	Not purchasing	516 (63.1)	194 (23.7)	108 (13.2)	818 (100)	0.626
	Purchasing	52 (58.4)	25 (28.1)	12 (13.5)	89 (100)	
Popcorn	Not purchasing	543 (62.7)	210 (24.2)	113 (13)	866 (100)	0.747
	Purchasing	25 (61)	9 (522)	7 (17.1)	41 (100)	
Nuts	Not purchasing	552 (62.7)	212 (24.1)	116 (13.2)	880 (100)	0.921
	Purchasing	16 (59.3)	7 (25.9)	4 (14.8)	27 (100)	
Color candy	Not purchasing	548 (62.7)	211 (24.1)	115 (13.2)	874 (100)	0.967
	Purchasing	20 (60.6)	8 (24.2)	5 (15.2)	33 (100)	
Meatball sandwich	Not purchasing	518 (64.8)	192 (24)	89 (11.1)	799 (100)	0.000
	Purchasing	50 (46.3)	27 (25)	31 (28.7)	108 (100)	
Chicken doner	Not purchasing	413 (69.9)	136 (23)	42 (7.1)	591 (100)	0.000
	Purchasing	155 (49.1)	83 (26.3)	78 (24.7)	316 (100)	
Schnitzel	Not purchasing	558 (63.3)	215 (24.4)	108 (12.3)	881 (100)	0.000
	Purchasing	10 (38.5)	4 (15.4)	12 (46.2)	26 (100)	

Table 4: Continue

	Purchase Status	Normal/underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	p
Hamburger	Not purchasing	449 (62.4)	178 (24.7)	93 (12.9)	720 (100)	0.673
	Purchasing	119 (63.6)	41 (21.9)	27 (14.4)	187 (100)	
Toast	Not purchasing	281 (61.8)	116 (25.5)	58 (12.7)	455 (100)	0.610
	Purchasing	287 (63.5)	103 (22.8)	62 (13.7)	452 (100)	
Pizza	Not purchasing	553 (63.2)	208 (23.8)	114 (13)	875 (100)	0.168
	Purchasing	15 (46.9)	11 (34.4)	6 (18.8)	32 (100)	
Raw meatball	Not purchasing	472 (64)	177 (24)	89 (12.1)	738 (100)	0.072
	Purchasing	96 (56.8)	42 (24.9)	31 (18.3)	169 (100)	
Soup	Not purchasing	566 (63.2)	214 (23.9)	115 (12.8)	895 (100)	0.003
	Purchasing	2 (16.7)	5 (41.7)	5 (41.7)	12 (100)	
Milk	Not purchasing	511 (63.3)	197 (24.4)	99 (12.3)	807 (100)	0.55
	Purchasing	57 (57)	22 (22)	21 (21)	100 (100)	
Buttermilk	Not purchasing	526 (64.6)	199 (24.4)	92 (11.3)	817 (100)	0.000
	Purchasing	42 (46.7)	20 (22.2)	28 (31.1)	90 (100)	
Coke	Not purchasing	491 (62.8)	190 (24.3)	101 (12.9)	782 (100)	0.796
	Purchasing	77 (61.6)	29 (23.2)	19 (15.2)	125 (100)	
Fruit juice	Not purchasing	271 (63.3)	107 (25)	50 (11.7)	428 (100)	0.415
	Purchasing	297 (62)	112 (23.4)	70 (14.6)	479 (100)	
Fruit-flavored soda	Not purchasing	511 (62.9)	197 (24.2)	105 (12.9)	813 (100)	0.727
	Purchasing	57 (60.6)	22 (23.4)	15 (16)	94 (100)	

P: Probability, BMI: Body Mass Index

Table 5: Relationship between frequency of purchase from the canteen, place where lunch is eaten, and student BMI

	Normal/underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	P
Frequency of purchases from the canteen					
Never	15 (71.4)	6 (28.3)	0 (0.0)	21 (100)	0.132
Rarely	115 (64.6)	46 (25.8)	17 (9.6)	178 (100)	
Occasionally	284 (64.3)	101 (22.9)	57 (12.9)	442 (100)	
Often	109 (59.2)	47 (25.5)	28 (15.2)	184 (100)	
Always	45 (54.9)	19 (23.2)	18 (22.0)	82 (100)	
Lunch in					
Yes	17 (56.7)	9 (30.0)	4 (13.3)	17 (56.7)	0.736
No	551 (62.8)	210 (23.9)	116 (13.2)	551 (62.8)	
Where lunch is eaten					
Walking home and eating at home	150 (64.4)	67 (28.8)	16 (6.9)	233 (100)	0.000
Taking a bus home and eating at home	40 (65.6)	14 (23.0)	7 (11.5)	61 (100)	
Bringing from home and eating at school	48 (67.6)	14 (19.7)	8 (12.7)	71 (100)	

Table 5: Continue

	Normal/underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	P
Eating at the canteen	155 (67.1)	53 (22.9)	23 (10.0)	231 (100)	0.000
Eating at the restaurant	42 (52.5)	18 (22.5)	20 (25.0)	80 (100)	
Sometimes canteen or restaurant	75 (51.0)	37 (25.2)	35 (23.8)	147 (100)	
Occasionally walking home for lunch or dining at the canteen	35 (81.4)	6 (14.0)	2 (4.7)	43 (100)	
Sometimes walking home and eating or dining at a restaurant	23 (56.1)	10 (24.4)	8 (19.5)	41 (100)	

n: Number, P: Probability

Table 5 presents the relationship between the frequency of purchases from the canteen, the location where lunch is eaten, and student BMI. Regarding the frequency of canteen purchases, no statistically significant differences were observed in the distribution of BMI categories (normal/underweight, overweight, and obese) (p=0.132). However, significant associations were found between where lunch is eaten and BMI categories (p<0.001). Notably, a higher percentage of students who walked home had normal/underweight BMI. Students who ate at the canteen, restaurant, or both canteen and restaurant showed varying distributions across BMI categories. Further analysis indicates a potential correlation between lunch location and student BMI status.

Within the study's parameters, four schools held a Nutrition-Friendly School Certification (with an average obesity rate of 12.62%), whereas thirteen had a canteen supervision committee. Of these, thirteen school canteens were operated by private businesses, and one was managed by the school administration. None of the schools had vending machines, energy drinks, flavored drink powders, syrups, or water. In total, one canteen sold coke; four sold hamburgers; and three sold chips, French fries (with ketchup), and nugget sandwiches.

The distribution of student BMI according to some characteristics of the schools is given in Table 6. According to this table, the rate of obese and overweight students was

Table 6: Distribution of student BMI according to defining characteristics of schools

		Normal or underweight n (%)	Overweight n (%)	Obese n (%)	Total n (%)	P
Basketball court	Yes	527 (62.4)	203 (24.0)	115 (13.6)	845 (100)	0.478
	No	41 (66.1)	16 (25.8)	5 (8.1)	62 (100)	
Soccer field	Yes	520 (63.5)	190 (23.2)	109 (13.3)	819 (100)	0.126
	No	48 (54.5)	29 (33.0)	11 (12.5)	88 (100)	
Volleyball court	Yes	504 (63.8)	192 (24.3)	94 (11.9)	790 (100)	0.008
	No	64 (54.7)	27 (23.1)	26 (22.2)	117 (100)	
Table tennis	Yes	434 (63.4)	167 (24.4)	84 (12.3)	685 (100)	0.323
	No	134 (60.4)	52 (23.4)	36 (16.2)	222 (100)	
Indoor sports hall	Yes	103 (60.2)	39 (22.8)	29 (17.0)	171 (100)	0.278
	No	465 (63.2)	180 (24.5)	91 (12.4)	736 (100)	
Canteen supervision committee	Yes	524 (62.5)	201 (24.0)	114 (13.6)	839 (100)	0.553
	No	44 (64.7)	18 (26.5)	6 (8.8)	68 (100)	
Area per student >5 m^2	Yes	416 (63.8)	153 (23.5)	83 (12.7)	652 (100)	0.489
	No	152 (59.6)	66 (25.9)	37 (14.5)	255 (100)	

n: Number, P: Probability

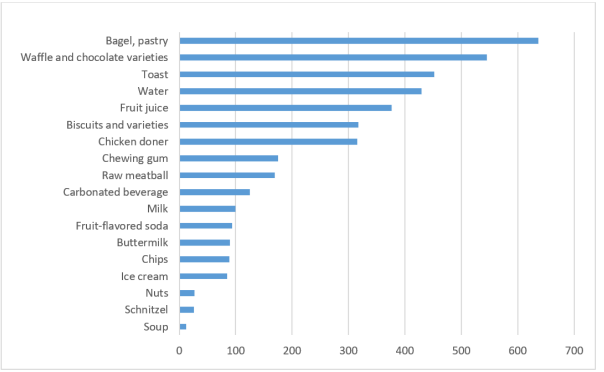

Figure 1: Frequency of food and beverage purchase from the school canteen by students

higher in schools without a volleyball court than schools with a volleyball court.

DISCUSSION

According to WHO data, the obesity rate among children aged 10–19 in 2016 was 20.7% in the US, 11.4% in Canada, 9% in Brazil, 6.9% in France, 16.7% in Saudi Arabia, and 2.5% in Japan. In Türkiye, the obesity rate in the same age group in the same year was 9.8% (girls: 9.4%, boys: 10.2%) (1).

Our findings revealed that 24% of the students were overweight and 13% were obese. When comparing these values with international and national literature, the obesity rates in our study are lower than those in the US, Canada, and Saudi Arabia, but higher than those in Brazil, France, Austria, and Japan (15, 17, 18). When looking at the results of studies in different regions of Türkiye, it can be seen that the overweight and obesity rates in our study are higher than in most areas (7, 19, 20). This situation can be due to differences in age distribution in study groups, references used to determine BMI values, or regional differences.

According to the study, the overweight and obesity rate in the 10–14 age groups was significantly higher in boys than in girls. Similar results have been found in studies conducted in different countries and other regions of Türkiye, where the overweight and obesity rates were either significantly higher in both groups or only boys (11, 18). However, studies have shown that obesity is higher in girls than boys (21, 22).

In some studies conducted in Türkiye and other countries, breast milk did not protect against obesity (23, 24). Breast milk can focus on the hypothesis that it will protect against obesity in the future by reducing weight gain during infancy compared to formula milk, as it contains lower protein and energy (25). Many systematic reviews and meta-analyses of observational studies have investigated the relationship between breastfeeding and obesity risk (26). Some studies have shown that breast milk provides a protective effect against obesity in childhood (27-29). In our study, no significant relationship existed between the number of siblings, order of siblings, and student BMI (Table 1). Consistently, Nabavi et al. and Uskun et al. did not find a significant difference between the number of siblings and order of siblings and obesity (23, 30). In our study, there was no statistically significant difference between school achievement and obesity. Our results showed similarities with some domestic studies (30, 31) but differed from others (19, 20).

In studies conducted on primary school students in Yemen and Kastamonu in Türkiye, a positive relationship was found between the education level of parents and the prevalence of overweight/obesity (32, 33). By contrast, similar studies conducted in Germany, China, and İzmir in Türkiye found a negative relationship between the education level of parents and prevalence of overweight/obesity (18, 34, 35). Although this difference was not statistically significant in our study, there are similar studies in terms of results. In some domestic and international studies, there was no statistically significant relationship between the education level of parents and prevalence of obesity, which is identical to this study (13, 23, 30, 36). Our study had no statistically significant relationship between chronic illnesses and BMI changes. Some studies in the literature support our results (7, 20, 37).

Many studies show that there is a strong connection between obesity and genetics. Individuals with a family history of obesity are more likely to become obese (8, 38). Studies have found that if both parents are obese, the likelihood of their children becoming obese is 80%. If only one parent is obese, the rate is 50%, and if neither parent is obese, the rate is 9% (39). In a study conducted by Tchicaya and Lorentz in Luxembourg, the likelihood of a child becoming overweight or obese was 6.51-fold higher if at least one of the parents was obese, compared with children with both parents at a normal weight (40). In addition to genetic and hereditary factors, parent attitudes toward life, physical activity, and eating habits can influence a child's eating and behavior choices. If a parent has poor eating habits, children can continue these habits. According to a study by Wardle et al., in a taste test, children from obese/overweight families preferred fatty foods more, liked vegetables less, and had a more "excessive eating" type of meal style (41). In our study, obesity rate was 30.1% in children whose parents were overweight or obese and 8.9% in children whose parents were not obese. Our study results were similar to those from other studies conducted domestically and abroad (18, 23, 31, 42), and a positive relationship was found between the obesity status of the parents and the obesity distributions of the children. The difference in our study

results could be due to differences in the amount of energy and types of food consumed by the students in one meal. Overweight and obesity rate was higher for students who did not eat breakfast, but the difference was not statistically significant. Students who frequently or consistently purchased food and drinks from the school cafeteria had a higher rate of overweight and obesity than those who rarely or never bought food. However, the difference was not statistically significant.

Li et al. showed a weak relationship between pocket money and obesity in schools that banned the sale of unhealthy food (43). In our study, obesity rate was significantly higher among students who had lunch outside of school at restaurants, including fast-food restaurants, than others. Thus, dining at restaurants is a contributing factor to obesity. Walking to school provides significant potential in maintaining the daily physical activity required for children, and thus, fighting obesity. The safety of the streets for walking between home and school is critical (44). Regarding public health, walking to school has a significant physical activity potential for children (45).

Our study found that the rate of overweight and obesity among students who accessed the school by car was higher, although statistically insignificant, than those who walked. There was no statistically significant relationship between the student's mode of transportation between home and school and their BMI distribution in our study. However, some studies have obtained similar results (13, 20, 30, 37).

Studies have suggested that sleep, a sedentary lifestyle, and physical activity status can affect weight through sleep deprivation on appetite, physical activity, and thermoregulation (18). A systematic review by Patel and Hu of cross-sectional and cohort studies in 1966–2007 found that short sleep duration in children is strongly and consistently associated with concurrent and future obesity (46). In a study conducted in China, Xiaoqing et al. showed that less sleep caused overweight and obesity in children and more sleep was a protective factor against obesity (18). According to the results of our study regarding the relationship between sleep duration and changes in BMI, the rates of overweight/obesity among students who slept for <6 h were high, although not statistically significant. Some of the results of the studies are similar to our results (20, 37), whereas others are different (7, 18). To better define the causal impact of sleep deprivation on obesity, more research is needed using objective measurements of sleep duration, repeated evaluations of sleep and weight, and experimental study designs that manipulate sleep (46). The shift from outdoor play to indoor entertainment, watching television, spending time on Internet, and playing computer games (47), has rapidly increased childhood obesity. Watching television contributes to obesity in children by reducing physical activity and encouraging people to consume more snacks while watching TV, as well as through the impact of advertisements on unhealthy food and beverage choices (48). A longitudinal observational study by Wiecha et al. showed that increasing daily TV viewing by 1 h caused teens to consume an additional 160 calories daily (49). Most international and national studies have found a positive correlation between TV viewing and obesity (18, 30, 39, 50).

According to our research, students who spent ≤30 min playing computer games or on Internet had a lower obesity rate (7.3%) than those who spent >30 min. However, this difference was not statistically significant. By contrast, students who spent >240 min had a higher obesity rate (29.5%) than those who spent less time, but this difference was not statistically significant. According to Siddarth, computer game time and obesity had a statistically significant positive relationship (50). Although our study did not find a meaningful relationship between time spent at the computer and BMI distribution, some studies support our results (20, 23, 36).

Our study found that people who exercise <1 h per week have a higher rate of overweight and obesity than other groups, which was statistically significant. This result is consistent with other studies (13, 30, 31, 36, 37).

CONCLUSIONS

In addition to the multifaceted approach needed to address childhood obesity, our study underscores the critical role of physical activity in promoting healthy lifestyles among children. Encouraging regular participation in sports and physical activities from an early age can help mitigate obesity risk by promoting cardiovascular health, improving muscle strength, and enhancing overall well-being. Initiatives aimed at creating safe and accessible spaces for recreational activities within schools and communities are essential for fostering a culture of active living among children.

Our findings highlight the importance of implementing policies that restrict the availability of high-calorie foods and beverages in school canteens. By prohibiting the sale of unhealthy snacks and promoting nutritious options, such as fruits, vegetables, and whole grains, schools can create an environment that supports healthy eating habits and contributes to the prevention of childhood obesity. Collaborative efforts between educational institutions, policymakers, and food suppliers are crucial for effectively implementing and enforcing such policies.

Our study underscores the need for comprehensive education on healthy diets and nutrition for students and their families. Educational programs can empower indi-

viduals to make informed decisions about their dietary habits and lifestyles by providing evidence-based information on balanced nutrition, portion control, and the importance of diverse food choices. Moreover, initiatives promoting cooking skills, meal planning, and grocery shopping strategies can further support families in adopting healthier eating habits and reducing the risk of childhood obesity.

In conclusion, addressing childhood obesity requires a holistic approach, encompassing various interventions targeting individual behaviors, environmental influences, and societal norms. By promoting physical activity, regulating food environments, and providing education about healthy diets, we can work together to combat the epidemic of childhood obesity and promote the health and wellbeing of future generations.

Ethics Committee Approval: The study has ethical approval from the National Education Directorates of Karabük and Safranbolu" and Non-Interventional Clinical Research Ethics Committee (Date: 10.03.2019, No: 3/12).

Informed Consent: Written consent was obtained from the families of all participants.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- E.K., H.G.; Data Acquisition- E.K.; Data Analysis/Interpretation- E.K., H.G.; Drafting Manuscript- E.K., H.G.; Critical Revision of Manuscript- H.G.; Final Approval and Accountability- E.K., H.G.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study received no financial support.

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