

Investigation of the relationship between short sleep duration and body mass index, nutritional habits and daily screen time in children (6-12 years)

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Abstract

Aim: The aim of this study is to evaluate obesogenic lifestyle and nutritional habits in a single study including a large population of children.

Materials and Methods: A cross-sectional study was conducted with children aged between 6-12 years from 5 primary schools (n = 1002) in Istanbul, Turkey between April–June 2019. A questionnaire was filled which included information about weight, height, sleep duration, daily screen time and eating habits.

Results: It was observed that obese children had significantly shorter sleep duration compared to children in other body mass index (BMI) groups (p = 0.001). It was found that median age was higher in children who slept less than 9 hours compared to those who slept 9 hours or more (p = 0.001). We also found that the median daily screen time of children who slept less than 9 hours was higher than the rest (p = 0.024).

Conclusion: There was a significant relationship between short sleep duration and overweight / obesity prevalence and increased daily screen time. Sleep duration can be a potentially modifiable risk factor in the prevention and treatment of childhood obesity.

Keywords: Eating habits; obesity; primary school; sleep duration

INTRODUCTION

Children should have adequate and healthy eating habits in order to develop their physical and mental skills. Obesity is one of the most important childhood health problems caused by nutrition. Its prevalence has increased rapidly in developing countries as well as in developed countries, with alarming levels reported in the past decade (1). Childhood obesity is associated with a wide range of comorbid conditions, including hypertension, early puberty and menarche, polycystic ovarian syndrome, cardiovascular disease, dyslipidemia, hyperinsulinemia, type 2 diabetes, metabolic syndrome, obstructive sleep apnea and other psychosocial conditions (2). Obesity is a multifactorial problem and its development is often attributed to the relationships and interactions between genes, lifestyle and the environment (3). The predictors of childhood obesity have been the subject of many studies worldwide (4,5). Physical activity, sedentary lifestyle and diet are the key modifiable risk factors of obesity (5-7). In the past decade, there has been growing evidence in

support of the role of short sleep time as a new risk factor for weight gain and obesity (8,9). According to findings from recent studies, children with less daily sleep were reported to have higher Body Mass Index (BMI) (10,11). Such results have been replicated in studies involving different races and ethnic groups, indicating that the relationship between short sleep and increased body mass index (BMI) in children is not associated with these characteristics (8,12,13).

The recommended duration of sleep is related to developmental stages and show some differences from the childhood to adolescence and beyond. It is considered sufficient for children to sleep between 9 and 10 hours during the middle childhood (6-12 years of age) (14). Epidemiological studies show that children in the middle childhood generally sleep for an average of 9 hours (15-17). In recent years, studies drawing data internationally have shown a gradual decrease in the average sleep duration (18,19). This downward trend in the amount of sleep on a global scale seems to have occurred at the

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same time as the frightening increase in the frequency of obesity (19). The increase in daily screen time and the use of electronic devices before bedtime in children may have also contributed to this trend (20). In addition, short sleep time can promote unhealthy eating behavior patterns or habits (21) such as eating without being hungry, eating in response to emotional stress, and preference for obesogenic food (sweet, chocolate, carbs) (22). These sleep and eating behaviors are related to both biological and behavioral mechanisms (23). The aim of this study is to investigate whether being overweight or obese was related to short sleep duration, and daily behaviors and habits in children 6-12-year-old Turkish children. Based on the reported relationship between sleep duration, obesity and the impact of lifestyle factors, it was also hypothesized that daily total screen time and other daily behaviors and habits may be related to sleep duration.

MATERIALS and METHODS

During the three months from April to June 2019, a cross-sectional study involving the filling of a questionnaire was carried out in 5 primary schools in Istanbul, Turkey. The schools were determined after obtaining necessary permissions from the Istanbul Directorate of National Education and the Governorship of Istanbul.

Ethics

Approval for the conduct of this study was obtained from Istanbul Training and Research Hospital Clinical Research Ethics Committee (Approval Number: 1696, Approval Date: 15.02.2019). The study was carried out in accordance with the Declaration of Helsinki and Good Clinical Practice (GCP) Guidelines. Informed consent forms were obtained from the parents of all children participating in the study.

Study Group and Characteristics

The study group consisted of 7-12-year-old children attending the 5 primary schools chosen for the study. Acceptance of participation, and not having any chronic disease or disabilities that could affect normal physical activity were the inclusion criteria for the study. Schools in our region were divided into two according to their socio-economic levels. Then, one school from each group was randomly selected through the SPSS program.

The threshold for daily duration of sleep was set at 9 hours for this study according to epidemiological data in this age group.

Questionnaire and Measurements

The Surveys were sent out to the schools by the Istanbul Provincial Directorate of National Education. The questionnaires were filled by the parents, and they were asked about the height, weight, age, and the lifestyle and eating habits of their children. Complete questionnaires were obtained from a total of 1002 children, and all final forms were collected at the Istanbul Training and Research Hospital. In order to confirm the accuracy of numerical data (height-weight), 150 of the 1002 children who completed the survey were checked for height and weight by a member of the research staff. These measurements were performed with a Seca brand pediatric scale and height

meter. Body mass index of each participant was calculated by using these data. The underweight, normal, overweight, and obese groups were created by using the percentile curves determined for Turkish boys and girls (24). Children whose BMI values were below the 5th percentile for age were considered as underweight, those who were between the 5th and 85th percentiles were considered normal weight, those who were in the 85th and 95th percentile range were considered overweight, and those with values above the 95th percentile were considered as obese. The survey also included information about average daily sleep duration, total screen time, total study time (homework), and the eating habits of the children.

Statistical Analysis

All statistical analyses were performed by using the SPSS software, version 25. Mean, standard deviation, median, and 25th-75th percentile scores were used in the representation of continuous data. The frequency and percentage values were used to depict categorical data. The conformity of continuous data to normal distribution was tested with the Kolmogorov Smirnov test. Chi-square tests were used to compare categorical data. The independent samples t-test or the Mann Whitney-U test were used to compare quantitative values according to conformity to normal distribution. The Kruskal Wallis test with Bonferroni correction was used to compare mean values among >2 groups. $p < 0.05$ value was accepted to demonstrate statistical significance.

RESULTS

Table 1. Comparison of Characteristics According to Duration of Sleep			
	Sleep Duration		P value
	<9 hours (n=216)	≥9 hours (n=786)	
Age (years)	10 (9-10)	9 (8-10)	0.001
Gender (n, %)			
Female	118 (54.6%)	418 (53.2%)	0.705
Male	98 (45.4%)	368 (46.8%)	
Total Screen Time (hours)	2 (2-3)	2 (1-2)	0.024
Total Study Duration (hours)	2 (1-2)	2 (1-2)	0.475
Number of meals a day			
3 meals	159 (73.6%)	577 (73.4%)	0.953
4-6 meals	57 (26.4%)	209 (26.6%)	
Eating with the Family			
Yes	206 (95.4%)	761 (96.8%)	0.304
No	10 (4.6%)	25 (3.2%)	
Eating Fast			
Yes	55 (25.5%)	175 (22.3%)	0.322
No	161 (74.5%)	611 (77.7%)	

Continuous data are expressed as Median (25th-75th percentile) values

Mean age of the overall study group was 9.22 ± 1.15 years. 53.5% ($n = 536$) of the participants were male and 46.5% ($n = 466$) of them were female. It was found that the median age of the children who slept less than 9 hours was higher than the children who slept 9 hours or more ($p = 0.001$). The median daily screen time of children who slept less than 9 hours was also found to be higher than those sleeping longer than 9 hours ($p = 0.024$). There was no difference found between children sleeping less than 9 hours and children sleeping 9 hours or more in terms of gender, time spent with school work, number of meals, eating together their family, and the speed of eating (Table 1).

In the study group, 13.6% ($n = 136$) of the children were evaluated to be underweight, 68.4% ($n = 685$) of them were normal weight, 11% ($n = 110$) of them were overweight, and 7.1% ($n = 71$) were obese. It was observed that obese children had significantly shorter sleep duration compared to the other groups ($p = 0.001$). The sleep duration of the other groups were similar. (Table 2).

Table 2. Distribution of Sleep Duration in BMI Groups

	Sleep Duration		P value
	Mean (SD)	Median (25-75 percentile)	
Underweight	9.54 ± 1.02	10 (9 - 10) ^b	0.001
Normal weight	9.36 ± 1.01	9 (9 - 10) ^b	
Overweight	9.37 ± 0.98	10 (9 - 10) ^b	
Obese	8.77 ± 0.83	9 (8 - 9) ^a	

DISCUSSION

This study expands knowledge concerning the relationships between short sleep duration in children and being overweight or obese. Our findings also add to the literature in terms of characterizing the number of meals, daily screen time, eating with family and eating speed. Another important strength of the study is inclusion of a respectably large sample group representing children aged 6–12 years. In our study, we found that there was an inverse proportion between sleep duration and screen time, as well as a significant relationship between sleep duration and being overweight or having obesity. These results were consistent with the majority of previous studies on this topic (8-13,25-27). However, it is very difficult to compare our results with previous studies, mainly because of the different ranges used by each author to classify sleep duration. Nevertheless, our results identify sleep duration as a risk factor for childhood obesity, but it is difficult to quantify the relationship.

Physical activity and nutrition are the main factors associated with obesity and have been extensively studied for their role in its prevention worldwide. Our study showed that sleep behavior should be considered in future public health measures to prevent childhood obesity. It is also interesting that shorter sleep duration was associated

with lower self-esteem and higher depressive symptoms in the 11–14 age group (28), indicating that shorter sleep is associated with other factors involved in daily activity and nutritional habits. In addition, obese children and adolescents often have a lower quality of life, which may be associated with depressive symptoms (29). This shows that, in the future, studies that employ methods to ascertain the effects of sleep duration and well-known risk factors in personal behavior and psychology are needed to determine clear relationships between these characteristics.

Unlike homeostatic hunger, sleep disorders can promote dietary intake in response to hedonic causes (30,31). Short sleep duration can induce emotional overeating behavior by reducing the child's capacity to deal with stress (21). However, the relationship between short sleep duration and obesity seems to be anything but simple. There are studies suggesting that altered growth hormone (GH) secretion may be one of the factors tying childhood obesity to abnormal sleep (32). The level of GH is usually increased during the initial period of sleep and periods of non-REM sleep with some increases during the rest of the night (33). Therefore, higher release of GH can be achieved with prolonged sleep. The high activity of the somatotrophic axis can increase GH-mediated lipolysis, thereby reducing the risk of obesity (34). As indicated in both clinical and experimental studies, inadequate sleep causes multiple metabolic and hormonal changes, including decreased glucose tolerance, increased cortisol levels, and sympathovagal response (35). Short sleep duration can pathophysiologically affect the development of obesity in a variety of ways, including increased sympathetic activity, high cortisol and ghrelin levels, decreased leptin, or impaired glucose tolerance (36).

Another important result of this study was the relationship between screen time and sleep duration. According to a systematic literature review, which included 67 studies investigating the effect of the daily screen time of children, 90% of the studies were found to show that there is an inverse relationship between screen time and sleep duration, similar to our study (37). It was observed that the majority of children exceeded the daily screen time limit (≤ 2 hours) recommended by the American Academy of Pediatrics (38). In order to minimize the harmful effects of daily screen time on sleep quality and duration, the screen exposure of children should be limited, especially before bedtime. Current studies evaluating the effect of screen time on sleep have several methodological limitations. However, various studies from around the world show consistency (37). In the light of current evidence, besides the effect of daily screen time on obesity, the effects of screen time on sleep duration should be taken into consideration. It is important to address this issue carefully in combating childhood obesity.

In this study, there was no significant difference between sleep duration and the frequency of eating with the family. Although we could not find any studies assessing this

relationship, it should be noted that there are a few articles in the literature that emphasize an inverse relationship between eating with the family and obesity (39).

In this study, there was no relationship found between sleep duration and the number of meals per day. Although there are studies in the literature that report a relationship between obesity and increased frequency of eating in children (40,41), there was no study investigating a relationship between the number of meals per day and sleep duration. The socioeconomic characteristics of a family may indeed affect the number of meals per day, while it is also possible that a child with irregular eating habits may not be able to grasp the conceptual difference between a meal and a snack; thus, the child may report unreliable information to their parent. Nevertheless, the increase in the number of meals per day can be accepted to be closely correlated with the amount of food intake, and could be indirectly associated with obesity. From our viewpoint, it is important to consider that sleep duration and also its quality may also be associated with eating behavior. It is evident that more detailed measurements are required in this subject.

CONCLUSION

This study was important in terms of covering a large sample group and examining other eating habits along with the BMI index. But there are some limitations. Since daily sleep duration can be perceived as time spent in bed, it was predicted that the reported sleep hours could be longer than the actual amount of sleep in children. Additionally, although various variables are addressed in this study, other risk factors of obesity, such as physical activity, depression and genetic characteristics were not measured. Considering the previously reported relationships between parental weight and childhood obesity, we must suggest further studies that account for these parameters in their analysis. Nevertheless, since sleep duration and screen time are potentially modifiable risk factors, the results of our study offer various public health recommendations for the prevention of childhood obesity.

Conflict of interest: The authors declare that they have no competing interest.

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