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Adolescent Obesity and Sedentary Screen Time: A Public Health Perspective

Baha'a M. Abu Salma[1,*], Omar Albogai[1], Mohammed O. Ibrahim[2]

[1]Department of Nutrition and Food Sciences, Faculty of Agriculture, Jerash University, Jordan
[2]Department of Nutrition and Food Technology, Faculty of Agriculture, Mutah University, Karak 61710, Jordan

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Abstract Adolescents are increasingly using digital devices, leading to a sedentary lifestyle and unhealthy eating habits, which in turn increases the risk of obesity. The study explores the relationship between screening time exposure and the prevalence of obesity among adolescents. A cross-sectional study was conducted on (n = 511) adolescents. A structured questionnaire was used to determine socio-demographic data and dietary and physical activity patterns. Body mass index adjusted for age was used to determine obesity levels. Multiple logistic regression was used to predict the probability of obesity based on screen time. The prevalence of obesity was higher among late adolescents aged ≥ 18 years by 44.4%. The overweight group (84.9%) tended to consume more than four meals per day, and 47.3% practiced physical activity less than one time per week. In addition, there is a positive correlation between electronic screen time and body mass index, and the odds of being overweight are 4.5 times higher when exposed to 2-3 hours of smart screen time than in the unexposed group. Prolonged screen time contributes to a sedentary lifestyle, unhealthy eating habits, and increased risk of obesity among adolescents. Public health policies should limit school screen time activity and increase physical education.

Keywords Obesity, Adolescents, Physical Activity, Eating Pattern, Jordan

1. Introduction

Obesity is a significant public health issue that places substantial health and economic burdens on a global scale. The increasing incidence of overweight and obesity is a matter of great concern, manifesting persistently across both developed and developing nations worldwide. The rate of obesity has doubled among adults and increased fourfold among children and adolescents. The obesity rate reached 8% in 2022 among individuals aged 5 to 19 years [1]. In Jordan, obesity rates have been increasing since 2007 [2] and are associated with metabolic disorders. Obesity during adolescence increases the likelihood of becoming obese in adulthood [3].

Obesity is a condition that results from a significant imbalance between calories consumed and the calories burned by the body [4]. Obesity is a multifactorial disease, influenced by genetics, physical activity, and environmental and socio-cultural factors [5]. Modifiable risk factors, including engaging in regular physical activity and maintaining a balanced, healthy diet, play a major role in preventing obesity-related cardio-metabolic disorders [6]. Physically inactive adolescents are at a higher risk of adiposity, cardio-metabolic disorders, type I diabetes, and autoimmune diseases [7]. The World Health Organization (WHO) has strongly recommended that adolescents follow a routine of moderate to intense aerobic activity, preferably achieving an average of 60 minutes daily throughout the week. Alternatively, it is suggested that adolescents engage

in vigorous-intensity activities on a minimum of three days per week [8]. On the other hand, high-calorie intake from fat and increased sedentary lifestyles are the primary causes of obesity among adolescents [9]. Urbanization has led to reduced physical activity and poor dietary habits among adolescents. Nowadays, adolescents prefer using cars over walking, consuming high-fat diets, and spending excessive time on electronic devices rather than engaging in physical activity [10]. These activities have displaced physical activity, contributing to the rise in obesity and overweight cases among adolescents.

Prolonged screen time among adolescents is linked to reduced physical activity, poor dietary habits, and disrupted sleep [11, 12]. The use of electronic devices exposes adolescents to interactive and social digital media, increasing their exposure [13] to food and beverage marketing, and influencing their consumption patterns and purchase options [14]. Prolonged television viewing, particularly exceeding 5hr per day, is associated with an increase in adipose tissue accumulation, a significant rise in visceral fat, an enlargement of waist circumference, and an elevated risk of cardio-metabolic disorders in children and adolescents [15]. The relationship between Body Mass Index (BMI) and the increase in screen time, particularly through television and video games, has received considerable attention in recent studies. Furthermore, the effects of screen time extend beyond recreational activity, significantly influencing the BMI-age-Z score. Screen time on weekends is linked to higher body fat percentage, but not BMI [12]. Moreover, higher adiposity during childhood and adolescence period is more susceptible to cardio-metabolic disorders risk during adulthood [16].

Jordan experiences rapid urbanization and lifestyle changes including increased access to digital devices and shifting toward cultural acceptance of sedentary indoor screen time entertainment. Obesity rates among adolescents have been rising in Jordan, which poses a significant health risk. Therefore, the exploration of the relationship between screen time and obesity among adolescents in Jordan remains limited in scope. Despite the growing prevalence of sedentary behaviors and the increasing allure of digital devices, the existing body of research has yet to comprehensively address this pressing issue. Understanding the influence of exposure to screen time is crucial in developing effective public health strategies and addressing the need for behavioral modification among adolescents. Therefore, the objective of this study is to explore the relationship between screening time exposure and the prevalence of obesity in Jordanian adolescents.

2. Materials and Methods

2.1. Study Design and Sampling

A cross-sectional prospective study was conducted on (n=511) participants aged 11-19 at five private schools in Amman from January to June 2024. Amman, the capital of Jordan, has a population of 2.246 million individuals aged between 15 and 24, which constitutes 42% of the total youth population in the country. Adolescents between 15 - 18 years make up 50.1% of the total youth population [17].

A qualified school nurse interviewed all participants. A structured questionnaire was developed, including questions related to sociodemographic and economic variables. The following data were collected: age, sex, and family income which were defined as (low-income < 600 Jordanian Dinars (JDs) per month, moderate-income 600-999 JD, and high-income $\geqslant$ 1000 JD). The patterns and duration of physical activity were obtained through self-reported data from the participants.

Screen time was calculated by the self-reported use of electronic entertainment devices, including televisions, laptops, mobile devices, and tablets, over seven days, including the weekend and excluding school-related activities. The mean time spent on screens was then determined.

This study was conducted in accordance to the principles of the Declaration of Helsinki, ensuring the ethical treatment of all participants. Ethical approval was obtained from Jerash University's Institutional Review Board (IRB), number 2955/6/2/9/AB. The participants' parents filled out the consent form before their enrollment in the study.

2.2. Anthropometric Measurements

The students' body weight was measured using a Tanita body composition analyzer SC-330 with the students wearing light clothes and no shoes. Their height was measured using a Seca 213 portable height measure, and the average of the two measurements was rounded to the nearest millimeter. Body Mass Index (BMI) was calculated by dividing the weight in kilograms by the square of the height in meters [18]. The BMI to age categories are based on the Centers for Disease Control (CDC): underweight (BMI less than 5th percentile), normal weight (BMI between 5th and less than 85th percentile), overweight (BMI between 85th and less than 95th percentile), and obese (BMI equal to or greater than 95th percentile) [19].

2.3. Dietary Assessment

2.3.1. Dietary Diversity

The participants were asked to write the foods and beverages they consumed at home or outside the home in the past week for three days (2 non-consecutive days and one weekend day). Then the responses were grouped into eight food groups (grains, dried beans, meat/poultry or fish, fruits, green leafy vegetables, dairy products, sweets, and fat/oil).

The calculation of dietary diversity is based on the Food and Agriculture Organization of the United Nations [20] as follows: participants are considered to have high dietary

diversity if they consume six or more food groups, medium dietary diversity if they consume four to five food groups, and low dietary diversity if they consume three or fewer food groups.

2.4. Ethical Consideration

Written informed consent was obtained from the participant's parents. The study was performed according to the principles of the Declaration of Helsinki.

2.5. Statistical Analysis

Statistical evaluations were conducted utilizing SPSS version 22, which is a statistical software developed by IBM Corp., in Armonk, NY, USA. The characteristics of the participants at baseline were assessed using percentage calculations. To examine the distribution of data, the Shapiro-Wilk test was implemented to determine normality. An adjusted logistic regression analysis was applied to investigate the likelihood of developing overweight or obesity in relation to screen time. In this analysis, the dependent variable was represented by the Body Mass Index (BMI) measured in kilograms per square meter (Kg/m^2) adjusted for age, while the independent variable comprised the duration of screen time. Additionally, a linear regression model was employed to assess both the degree and strength of the association between various factors. Within this model, the dependent variable remained the BMI (Kg/m^2)concerning age, whereas the independent variables included screen time alongside the frequency of physical activity. A p-value of less than 0.05 was regarded as indicative of statistical significance, highlighting the robustness of the findings.

3. Results

Table 1 illustrates the classification of participants into four distinct categories according to their BMI percentiles: underweight, normal weight, overweight, and obese. Table 1 demonstrates that there are no significant differences observed between the various groups based on sex and age. However, 60.6% and 55.7% of participants were in the middle adolescence stage and the early adolescent stage respectively. At the same time, 2.2% of participants in the middle adolescence stage were both obese and underweight and 57.8% of the overweight participants had a family history of being overweight or obese. In addition, 63.4% of the normal-weight participants came from families with incomes of more than 1000 Jordanian dinars (JD), followed by 52.5% from families with incomes of less than 600 JD. In the overweight group, 84.9% tended to consume more than four meals per day, and 56% consumed snacks between meals, while 92.6% of the normal weight group tended to consume 2-3 meals per day, and 74.9% did not consume snacks between meals. Furthermore, 78.5% of the participants in the normal-weight group engaged in physical activity more than three times per week while the majority of the overweight group (47.3%) practiced physical activity less than once per week. Figure 1 illustrates that 47.1% of the participants used the school bus for transportation to school, while 22.6% used their parents' private cars.

The dietary diversity among participants is shown in Figure 2. 68.3% of participants consume more than six groups, 26% consume 3 to 5 food groups, and 5.7% consume less than three food groups. Additionally, the majority of participants consume 94.7% grains, 80.6% vegetables, 78.5% meats, poultry, and fish 54%, 89% dairy products, and 90.8% consume sweets.

The adjusted logistic regression analysis examines the relationship between electronic screen time and BMI among the participants which is shown in Table 2. The results show that the odds of being overweight are 4.5 times higher when exposed to 2-3 hours of smart screen time than in the unexposed group. This indicates a strong positive association between screen time and the risk of being overweight. Moreover, participants who spend less than one hour on screen time are 5.6 times more likely to have a normal weight compared to those with more screen time.

Linear regression analysis of the relationship between electronic screen time, frequency of physical activity, and BMI among the participants is shown in Table 3. The results show a positive relationship between electronic screen time and BMI, meaning that more screen time is associated with higher BMI. Specifically, for each additional hour of electronic screen time, BMI increases by 1.37 units. The analysis also suggests that 34% of the variation in BMI can be explained by electronic screen time, indicating a moderate relationship. Additionally, the results found a very slight negative relationship between the frequency of physical activity and BMI, with a B value of (-0.004). This means that for each unit increase in physical activity time, BMI decreases by (0.004) units, although this effect is very small.

Table 1. Socio-demographic, physical activity, and dietary patterns among participants groups

Variables	Underweight N= (11)	Normal weight N= (293)	Overweight N= (194)	Obese N= (13)	P - value
Age years (mean ± SD)	16 ±2				0.6
11-13 years	1 (1.6%)	34 (55.7%)	24 (39.3%)	2 (3.3%)	
14-17 years	7 (2.2%)	191 (60.6%)	110 (34.9%)	7 (2.2%)	
≥ 18 years	3 (2.2%)	68 (50.4%)	60 (44.4%)	4 (3%)	
Sex					0.4
Male	6 (2.2%)	147 (54.4%)	108 (40%)	9 (3.3%)	
Female	5 (2.1%)	146 (60.6%)	86 (35.7%)	194 (38%)	
Family history of overweight/ obesity					0.000*
Yes	8 (3.6%)	80 (35.9%)	129 (57.8%)	6 (2.7%)	
No	3 (1%)	213 (74%)	65 (22.6%)	7 (2.4%)	
Frequency of physical activity					0.000*
≤ 1 time	6 (2.7%)	103 (46.4%)	105 (47.3%)	8 (3.6%)	
2 times	3 (1.3%)	139 (62.1%)	78 (34.8%)	4 (1.8%)	
≥ 3 times	2 (3.1%)	51 (78.5)	11 (16.9%)	1 (1.5%)	
Frequency of main meal consumption					0.001*
One meal	1 (0.9%)	58 (50.4%)	52(45.2%)	4 (3.5%)	
2-3 meals	3 (1.2%)	226 (92.6%)	13 (5.3%)	2 (0.8%)	
≥ 4 meals	7 (4.6%)	9 (5.9%)	129 (84.9%)	7 (4.6%)	
Consumption of snacks between meals					0.000*
Yes	3 (1.4%)	88 (40%)	123 (56%)	6 (2.7%)	
No	8 (3.9%)	155 (74.9%)	37 (17.9%)	7 (3.3%)	
Sometimes	0	50 (22.7%)	34 (77.3%)	0	
Family monthly income (JD)					0.3
< 600 JD	2 (2.5%)	42 (52.5%)	36 (45%)	2 (2.4%)	
600 – 999 JD	5 (1.9%)	142 (54.8%)	104 (40.2%)	7 (2.7%)	
≥ 1000 JD	4 (2.3%)	109 (63.4%)	54 (31.4%)	4 (2.3%)	

JD: Jordanian dinar. *P- value was considered significant at $p < 0.05$

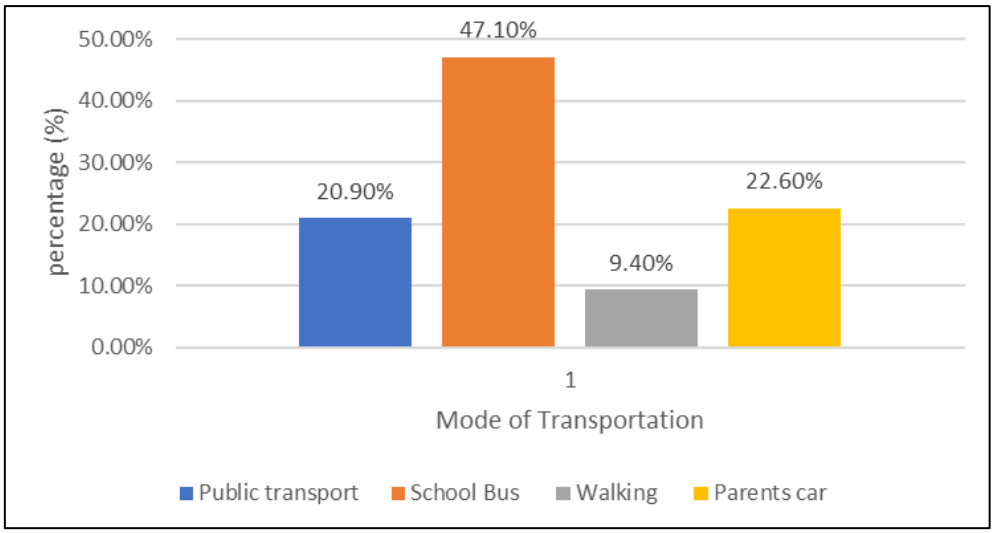

Figure 1. Transportation used

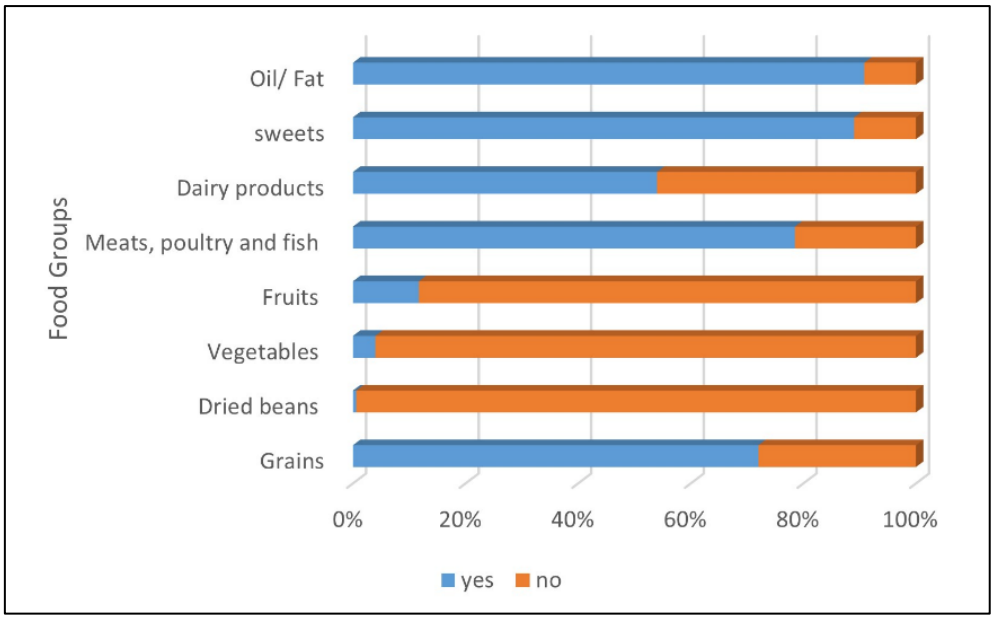

Figure 2. Frequency of dietary diversity among participants

Table 2. Logistic regression analysis of the relationship between electronic screen time and BMI among the participants

	Adjusted OR (95% CI)		
Time spent on electronic smart screen	**Underweight**	**Normal weight**	**Overweight / Obese**
≤ 1 hour daily	6 (0.53 -67.6)	5.6 (0.7 – 44.6)	1.6 (0.2 – 14)
2-3 hours daily	0.5 (0.04 – 6.02)	1.04 (0.3 – 4.0)	4.5 (1.2 – 17.3)
> 3 hours daily	1*	1*	1*

*The reference category is set to 1. The parameter is set to zero because it is redundant.

The model was adjusted to age, sex, and family income.

Table 3. Linear regression analysis of the relationship between electronic screen time, frequency of physical activity, and BMI among the participants

Variables	**B**	**R square**	**F**	**CI**	**P - value**
Electronic screen time	1.37	0.34	128.5	(1.2 – 1.5)	0.000*
Frequency of physical activity	-.004			(0.15 – 0.16)	

4. Discussion

Obesity has been escalating at a concerning rate globally. According to the World Health Organization, approximately 158 million children and adolescents are affected, with 81% residing in developing countries [21]. The rapid evolution of technology has greatly increased sedentary screen activity in almost all daily life activities across all age groups, especially among adolescents, leading to a higher risk of health issues associated with sedentary behaviors, particularly obesity. The relationship between the prevalence of obesity and exposure to technology screen time has become a public health concern. The study found that higher screen time is linked to a higher risk of being overweight, while participants with lower screen time showed protective effects against being overweight or obese. This indicates a strong positive relationship between lower screen time and maintaining a healthy weight. Increasing screen time is associated with an increase in BMI due to prolonged sedentary activity. The findings of the present study demonstrate that adolescents with obesity exhibited reduced levels of physical activity in comparison to their normal-weight counterparts. Furthermore, most students participate only in sports activities during school, using both public and private transportation and only a few of them walk to school. Additionally, most of the adolescents participating in the study consume more than six types of food groups,

indicating that the participants have dietary diversity. However, overweight adolescents are also more likely to consume more than four meals and frequently eat snacks between meals.

The findings of our research are consistent with those of a cross-sectional study that identified an increased likelihood of being overweight or obese among participants aged 10 to 17 years. This heightened risk was particularly evident in individuals who engaged in video gaming or used computers or handheld screens for durations exceeding one hour [22]. Spending three hours or more in front of a screen increases the risk of overweight or obesity by 38% among all age groups [23]. Moreover, meta-analysis studies found that sedentary life increases the odds of obesity by 1.42 and 1.52 among physical inactivity adult participants [24]. The prevalence of a sedentary lifestyle among adolescents has been increasingly recognized as a major contributor to the rising incidence of obesity, particularly as these individuals often prolonged periods engaging in screen time, resulting in a significant reduction in physical activity. A Mendelian randomized cross-sectional study found a causal relationship between physical activity and leisure screen time and the risk of obesity [25]. Moreover, engagement in physical activity, along with the recorded step counts from pedometers, exhibited an inverse relationship with various health indicators such as BMI, percentage of body fat, and circumference of the waist, while screen time was positively associated with waist circumference [26]. On the other hand, intermediate physical activity level sitting leisure time was associated with lower odds of metabolic risk after five to ten years [27]. Prolonged screen time in front of the television in the pre-adult stage is strongly associated with obesity in adulthood [28]. In contrast, previous studies have not found a link between playing digital games and the rates of overweight and obesity [29]. This may be because playing games is a less sedentary activity, and the studies were conducted at a time when access to the internet and computers was limited.

A screen sedentary life increases adolescents' exposure to fast food advertisements, which influence their food preference habits and purchasing options and increase their request for food particularly while they are using screen technology and during the night [30]. The potential mechanisms of the link between overweight and obesity among people who spend a lot of time in front of screens include consuming large amounts of unhealthy, high-fat, and high-sugar food, as well as frequent snacking which can lead to excessive calorie intake. In addition, replacing physical activity with a sedentary lifestyle can lower the basal metabolic rate, which creates a positive energy balance [31]. This imbalance can lead to fat deposition, particularly visceral fat, disrupting normal metabolic processes and causing insulin resistance. Furthermore, prolonged screen time, especially at night, may disrupt melatonin secretion, delay bedtime, stimulate ghrelin release, and increase appetite while suppressing leptin hormone, leading to hormonal imbalance and fat deposition [28, 32].

The current study is the first to explore the relationship between the prevalence of obesity and screen time-based activity in Jordan. This highlights the importance of developing new policies in schools to control screen time-based activity among adolescents and encourage them to increase their physical activity. However, the study has significant limitations. As a cross-sectional study, it cannot establish a causal relationship between screen time and the incidence of overweight and obesity. Furthermore, the research was conducted in educational settings where the use of technology is integrated into the learning process. Additionally, the findings were based on self-reports and parental reports regarding screen time and dietary habits.

5. Conclusions

In conclusion, the study results indicated that excessive screen time is linked to frequent snacking, reduced physical activity, and a higher risk of overweight and obesity. Therefore, it is important to educate families about the risks associated with prolonged screen time and unhealthy eating habits. Early screening for obesity risk is also essential to ensure timely management. Additionally, public health policies should be developed to promote access to affordable healthy food and encourage physical activity in schools.

An experimental longitudinal study should be conducted to examine the causal relationship. Governmental public health policies should be developed to address the root causes of obesity among adolescents. Additionally, active transportation and sidewalks should be considered when planning urban cities.

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Declaration of the Conflict of Interests

The authors state that they have no competing interests.

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Authors' Contributions

BMA is responsible for the study's conception and design, and manuscript writing. The data was collected by OA and MO. BMA performed the statistical analysis and interpretation of the data. All authors participated in writing and revising the draft of the manuscript. The final version of the manuscript was read and approved by all of the authors.

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