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Association of obesity with television and other screen viewing, physical activity and food intake among elementary school children in Jeddah, Saudi Arabia

Bushra A Shojoon*[1] and Najlaa M Aljefree[1]

[1]Food and Nutrition Department, Building 43, Room 237, Level 2, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, 3270, Saudi Arabia
* Correspondence: Email: bshojoon0001@Stu.kau.edu.sa.

Abstract: The prevalence of childhood obesity has greatly increased worldwide. Television viewing and other devices with screens are among contributing factors for obesity. This study included 282 elementary school children aged 6–13 years attending public and private schools in Jeddah. A self-administered online questionnaire distributed among the schools to collect data on sociodemographic characteristics, height, and weight, time spent on screens viewing, sleep duration and physical activity. The prevalence of overweight and obesity was 18.4% and 23.8%, respectively. Boys had a significantly higher risk of obesity (49.1%) than girls (37.6%) ($P < 0.05$). The majority of children had their own mobile phone (77.3%) and had their own tablet (56%). More than one-third of children spent 2–3 hours per day watching television and/or other devices. Children who played video games or watched videos 4 hours or more per day were more likely to be obese. Similarly, those who spent 4 hours or more per day using a mobile phone or tablet were more likely to be obese. Children who slept 6 hours or less were more likely to be obese. Children who exercised for 1 hour or less were less likely to be obese than those who never exercised. These findings call for the implementation of national programmes to reduce children's use of electronic devices and improve lifestyle behaviours to reduce the prevalence of obesity among Saudi children.

Keywords: Obesity, Physical activity, Screen viewing, TV watching, Elementary school children, Saudi Arabia

1. Introduction

Overweight and obesity among children is a complex health issue and a major concern worldwide. According to the World Health Organization (WHO), in 2016, the number of overweight and obese children aged 5–18 years reached 216 million and 125 million globally, respectively [1]. In Saudi Arabia, the prevalence of overweight and obesity and severe obesity among children aged 5–18 years in 2010 reached 23.1%, 9.3% and 2%, respectively [2]. Another study conducted in 2019 in Riyadh included 7,930 children aged 6–16 years. The prevalence of overweight and obesity among girls was 14.2% and 18%, respectively; among boys, the rates were 12% and 18.4%, respectively [3]. Likewise, national study in 2020 included 3613 school children in the western, central, and eastern regions in Saudi Arabia revealed a high prevalence (21.5%) of obesity in school children [4], which poses a great risk because obesity poses significant complications that can affect children in the long term.

Childhood obesity can lead to health issues in early adulthood as well as long-lasting health problems and diseases, including diabetes and heart disease [4,5]. Spending a long time every day watching television (TV) and/or using electronic devices, as well as a lack of physical activity, are

several factors that increase the risk of obesity in children. Children today are surrounded by different electronic devices that are easy to access and use, and parents face difficulty keeping their children otherwise occupied. Furthermore, an increase in screen watching time may lead to a decrease in physical activity, which in turn may increase the risk of obesity [5]. For instance, in the United States, watching TV excessively in the bedroom was found to have a strong association with increased odds of obesity among adolescents aged 12–17 years (OR = 2.5; 95% CI 1.9, 3.2) [6]. Similarly, in a study that included 6,025 children from 12 countries aged 9–11 years, the intensity of physical activity, high TV viewing and short sleep duration were significant behavioural correlates of obesity in children. Moreover, time spent watching TV was positively associated with obesity in children, especially boys. In contrast, the duration of nocturnal sleep and moderate-to-vigorous physical activity showed a negative correlation with obesity [7].

There is limited information on the prevalence of watching TV and other devices with screens (e.g. smartphones and tablets) and the association with overweight and obesity among Saudi children [8,9]. The previous studies illustrated a significantly positive association between watching Tv and other devices and risk of obesity [8,9]. To date, most international research examining this association has focused on TV viewing; however, in the current study, other devices with screens, such as tablets and smartphones, will also be included. Hence, the aim of this study is to assess the prevalence of overweight and obesity, and to examine the association of TV viewing and other screens viewing, such as (video viewing, video games, smartphones and tablets), physical activity, and sleep duration with the prevalence of overweight and obesity among elementary school children aged 6-12 years old in Jeddah.

2. Materials and Methods

2.1. Study Design and Participants

A cross-sectional study design was employed for the current study, which ran between June and December 2022 in Jeddah, Saudi Arabia. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine at King Abdulaziz University (Reference No. 245-22). Ethical approval was also obtained from the Department of Education in Jeddah.

According to the General Authority for Statistics, the current number of children in public elementary schools in Jeddah is about 233,146 (115,248 boys and 117,898 girls), and the number of children in private elementary schools is 95,258 (44,333 boys and 50,925 girls) [10]. Hence, the total population of elementary school children is about 328,404.

In Jeddah, there are 220 public elementary schools for boys and 228 for girls as well as 157 private elementary schools for boys and 232 for girls [11]. Schools were selected randomly from each of the four educational offices for girls (North, Centre, East and South) and the six administrative educational offices for boys (North, East, Centre, Naseem, South and Safa). An online sample size calculator determined that the sample size required for this study was 271 elementary school children, which was based on a 5% margin error, 99% confidence level and response distribution of 50%. [10].

Participants were included in the study if they were elementary school children (both gender) aged 6–13 years attending public or private schools in Jeddah. Participants were excluded if they were older than 13 years or attended public or private schools outside of Jeddah. Initially, 299 students were selected. After applying the inclusion and exclusion criteria, 282 elementary school children (112 boys and 170 girls) remained. The majority of the participants were from South and North Jeddah (45% and 21.12%, respectively), followed by East and Centre Jeddah (14.08% and 10.9%, respectively). The lowest percentages of participants came from the administrative offices of Naseem (6.69%) and Safa (2.11%).

2.2. Data Collection

The data collection was conducted through a self-administered online questionnaire distributed among the schools in each administrative area. The principal investigator visited the public and private schools of each administrative office after obtaining ethical approval from the Department of Education. At the schools, the principal investigator met with the participating teachers and forwarded them the questionnaire link. The teachers then forwarded the link to the children's parents. The online questionnaire had a short introduction that explained the research goals and emphasized that participation was voluntary and anonymous. Consent was obtained from each participant before the questionnaire was filled out, and it was explained that completion of the questionnaire indicated acceptance of participation in the study. The questions were written in Arabic and adapted from previous studies [12–17].

A pilot study that included 15 participants was conducted to verify the clarity of the questions. Moreover, the questionnaire was administered to three nutrition scientists in the Food and Nutrition Department at King Abdulaziz University to ensure that the questions could be easily understood by the respondents.

The questionnaire was completed by parents for their children and comprised six sections: children's and parents' sociodemographic information (parents' ages and relationship to the child, child's age, child's gender, with whom the child lives, parents' jobs, parents' educational levels, monthly family income), self-reported anthropometric measurements (height and weight), time spent watching TV and/or other devices with screens, including smartphones and tablets (nine questions include: the number of TVs in the household (with options from 1 to 6), yes-or-no questions about whether there is a TV in the child's bedroom and whether the child owns a smartphone or tablet, as well as the hours spent on TV, smartphones, tablets, and video games, with multiple-choice options [12], food intake while watching TV and other devices with screens includes three questions: the frequency of snack consumption with four response options ('never,' 'sometimes,' 'frequently,' or 'always'), the consumption of formal meals (breakfast, lunch, or dinner) while watching TV, and the frequency of consuming five 'unhealthy' food items and one 'healthy' food item while watching TV. Responses to the latter were measured on a seven-point scale ranging from 'never' to 'every day, more than once' [13-15], sleep duration during weekdays and weekends was measured using an eight-point scale ranging from '4 hours or less' to '11 hours or more [16] and physical activity (includes four categorical response questions about the child's physical activity, such as participation in sports, interest in physical activities, and mode of transportation (walking or vehicle). Additionally, a response frequency question measures the weekly duration of exercise at school, home, and outdoors, with options ranging from "never" to "4 hours or more.") [8, 17].

2.3. Statistical Analyses

Data analyses were performed using the Statistical Package for Social Science (SPSS) version 28. The characteristics of schoolchildren and their parents were represented via frequencies and percentages. Since the sample size was relatively small, the overweight and obesity categories were merged. A chi-square test was used to compare the viewing of TV and other devices with screens and lifestyle behaviours, including sleep duration and physical activity, of boys and girls. A chi-square test was also used to compare the food intake while watching TV and other devices with screens, including potato chips, fried food, snacks, ice cream, fast food, fruits and vegetables, of boys and girls. The associations between the risk of obesity (dependent) and the factors of viewing TV and other devices with screens, physical activity, food intake while watching TV and other devices with screens, and sleep duration (independent) were identified using separate logistic regression analyses. All models were adjusted for age, gender, family income, mother's occupation, father's occupation, mother's education and father's education. P-values ≤ 0.05 were considered statistically significant.

3. Results

The sociodemographic characteristics of the 282 study participants has been shown in Table 1. The majority of schoolchildren were girls (60.3%) aged 9–11 years old (42.2%) who studied at public schools (73%) and lived with both parents (91%). Also, for the majority of schoolchildren, their mothers were housewives (64.9%), while their fathers were government employees (40.2%). More than one-third of both fathers and mothers had bachelor's degrees or diplomas. The monthly income for schoolchildren's families was considered low, as 33% received 5,000–10,000 SAR per month and 27% received less than 5,000 SAR per month.

Table 1. Socio-demographic characteristics of study participants.

Charact eristics	**ll children (%)**
Age (Year)	
6-8	9 (35.1)
9-11	19 (42.2)
12-13	4 (22.7)
Gender	
Boys	12 (39.7)
Girls	70 (60.3)
Type of school	
Public school	05 (73)
Private school	7 (27)
Who do the child live with	
Parents	57 (91)
Mother	8 (6.4)
Father	(1.1)
Mother 's relatives	(1.4)
Mother occupation	

Self employed	(2.8)
Govern ment sector employee	9 (20.9)
Private sector employee	5 (8.9)
Housew ife	83 (64.9)
Student	(2.5)
	Father occupation
Self employed	5 (8.9)
Govern ment sector employee	19 (42.2)
Private sector employee	5 (33.6)
Labore r	6 (9.2)
Unempl oyed	6 (5.7)
Student	(0.4)
	Mother educational level
Less than high school	0 (17.7)
High school	1 (32.3)
Bachelo r/diploma	15 (40.8)
Postgra duate	6 (9.2)
	Father educational level
Less than high school	1 (11)
High school	01 (35.8)
Bachelo r/diploma	20 (42.6)
Postgra duate	0 (10.6)
	Family income level
Less than 5000	6 (27)

5000-10000	3 (33)
10001-15000	1 (18.1)
15001-20000	2 (11.3)
20001-25000	(2.8)
More than 25000	2 (7.8)

The prevalence of obesity among schoolchildren, stratified by gender, has been presented in Figure 1. The overall prevalence of overweight and obesity was 18.4% and 23.8%, respectively. Among boys, the prevalence of overweight and obesity was 20.5% and 28.6%, respectively, while among girls, the prevalence of overweight and obesity was 17.1% and 20.6%, respectively.

The risk of obesity among schoolchildren stratified by gender has been exhibited in Table 2. After combining the overweight and obesity rates, boys had a significantly higher risk of obesity (49.1%) than girls (37.6%) (P = 0.05). No other sociodemographic data showed significant results regarding the risk of obesity.

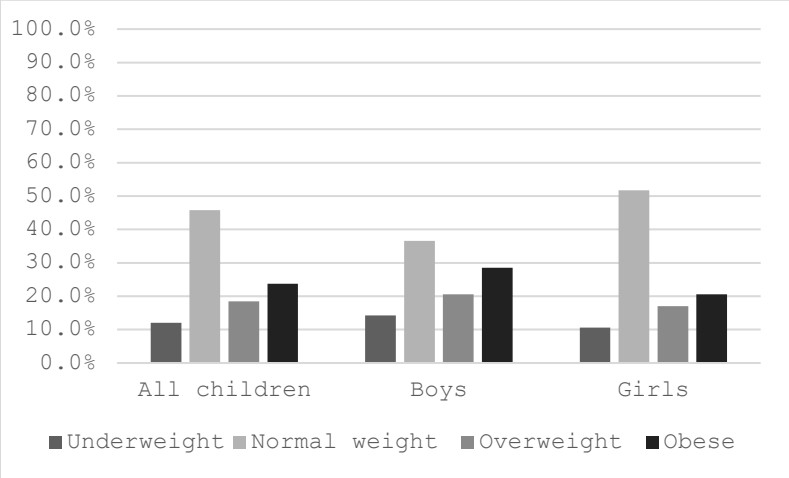

Figure 1. Prevalence of obesity, overweight, normal weight, and underweight among school children (n= 282) stratified by gender.

Table 2. Prevalence of obesity among school children stratified by gender.

BMI	**All children** *n* **(%)**	**Boys** *n* **(%)**	**Girls** *n* **(%)**	***P-value***
Non-obese	163 (57.8)	57 (50.9)	106 (62.4)	**0.05**

Risk of obesity	119 (42.2)	55 (49.1)	64 (37.6)

* *p*-Value based on X2 test, BMI: body mass index, Bold indicates significance p ≤ .05

Screen viewing habits among schoolchildren, stratified by gender has been displayed in Table 3. The majority of schoolchildren had 2 or fewer TVs at home (76%), had their own mobile phone (77.3%), had their own tablet (56%), and usually watched TV with one or both parents (60.6%). More than one-third of children spent 2–3 hours per day watching TV, playing video games, watching videos and/or using their mobile phones and/or tablets. Boys were significantly more likely than girls to have their own mobile phone (83% vs. 73%; P = 0.04), play video games (67.9% vs. 40.6%; P = 0.001), and have a TV in their bedroom (27.7% vs. 13.5%; P = 0.003). Boys were also significantly more likely than girls to watch TV for 4 or more hours per day (34.8% vs. 22.4%; P = 0.04).

Table 3. TV viewing and other screens viewing among school children stratified by gender.

TV viewing and other screens viewing	**All children *n* (%)**	**Boys *n* (%)**	**Girls *n* (%)**	***P-value***
How many TV in your home?				
2 or less TV	213 (75.5)	79 (70.5)	134 (78.8)	0.13
3 or 4 TV	59 (20.9)	30 (26.8)	29 (17.1)	
5 TV or more	10 (3.5)	3 (2.7)	7 (4.1)	
Do the child has TV in his/her bedroom?				
Yes	54 (19.1)	31 (27.7)	23 (13.5)	**0.003**
No	228 (80.9)	81 (72.3)	147 (86.5)	
Do the child has his/her own mobile phone?				
Yes	218 (77.3)	93 (83)	125 (73.5)	**0.04**
No	64 (22.7)	19 (17)	45 (26.5)	
Do the child has video game players?				
Yes	128 (45.4)	76 (67.9)	52 (30.6)	**0.001**
No	154 (54.6)	36 (32.1)	118 (69.4)	
Do the child has his/her own tablet?				
Yes	158 (56)	58 (51.8)	100 (59)	0.22
No	122 (44)	54 (49)	68 (40.6)	
How many hours per day does the child spend watching TV?				
1 hour or less	99 (35.1)	32 (28.6)	67 (39.4)	**0.04**
2-3 hours	106 (37.6)	41 (36.6)	65 (38.2)	
4 hours or more	77 (27.3)	39 (34.8)	38 (22.4)	
How many hours per day does the child spend playing video games or watching videos?				
1 hour or less	113 (40.1)	38 (33.9)	75 (44.1)	0.18
2-3 hours	101 (35.8)	42 (37.5)	59 (34.7)	
4 hours or more	68 (24.1)	32 (28.6)	36 (21.2)	
How many hours per day does the child spend on a mobile phone or tablet?				
1 hour or less	87 (30.9)	33 (29.5)	54 (31.8)	0.9
2-3 hours	105 (37.2)	42 (37.5)	63 (37.1)	
4 hours or more	90 (31.9)	37 (33)	53 (31.2)	

How does a child usually watch TV?				
Alone	79 (28)	32 (29.4)	47 (28.1)	0.97
With one or both parents	171 (60.6)	67 (61.5)	104 (62.3)	
With brothers/sisters	26 (9.2)	10 (9.2)	16 (9.6)	

* *p*-Value based on X2 test, Bold indicates significance p ≤ .05

Lifestyle behaviours among schoolchildren, stratified by gender has been presented in Table 4. The majority of schoolchildren slept 7–9 hours during the week (71.6%) and on weekends (63.8%), sometimes consumed snacks while watching TV (67%), and were, in their parent's perceptions, physically active (68.8%). Parents reported that their children exercised at school (62.4%), at home (44.7%), and outdoors (31.9%) for one hour or less per week. Boys were significantly more physically active than girls at school (P = 0.02) and outdoors (P = 0.001).

Table 4. Lifestyle behaviors among school children are stratified by gender.

Lifestyle behaviors	**All children *n* (%)**	**Boys *n* (%)**	**Girls *n* (%)**	***P-value***
Consumption of snacks while watching TV?				
Never	29 (10.3)	11 (9.8)	18 (10.8)	
Sometimes	189 (67)	83 (74.1)	106 (63.9)	0.18
Frequently	48 (17)	16 (14.3)	32 (19.3)	
Always	12 (4.3)	2 (1.8)	10 (6)	
Sleep duration during weekdays:				
6 hours or less	43 (15.2)	18 (16.1)	25 (14.7)	0.61
7-9 hours	202 (71.6)	82 (73.2)	120 (70.6)	
10 hours or more	73 (13.1)	12 (10.7)	25 (14.7)	
Sleep duration during weekends:				
6 hours or less	23 (8.2)	7 (6.3)	16 (9.4)	**0.05**
7-9 hours	180 (63.8)	81 (72.3)	99 (58.2)	
10 hours or more	79 (28)	24 (21.4)	55 (32.4)	
Is your child engaged in sports?				
Yes	137 (48.6)	56 (50)	81 (47.6)	0.6
No	145 (51.4)	56 (50)	89 (52.4)	
In your opinion, is your child physically active or sedentary?				
Active	194 (68.8)	78 (69.6)	116 (68.2)	0.5
Sedentary	86 (30.5)	34 (30.4)	52 (30.6)	
How many times does the child exercise per week at school?				
Never	53 (18.8)	13 (11.6)	40 (23.5)	
1 hour or less	176 (62.4)	71 (63.4)	105 (61.8)	**0.02**
2-3 hours	38 (13.5)	21 (18.8)	17 (10)	
4 hours or more	15 (5.3)	7 (6.3)	8 (4.7)	
How many times does the child exercise per week at home?				0.38
Never	113 (40.1)	44 (39.3)	69 (40.6)	

1 hour or less	126 (44.7)	50 (44.6)	76 (44.7)	
2-3 hours	34 (12.1)	12 (10.7)	22 (12.9)	
4 hours or more	9 (3.2)	6 (5.4)	3 (1.8)	
How many times does the child exercise outdoor per week?				
Never	107 (37.9)	34 (30.4)	73 (44.8)	
1 hour or less	90 (31.9)	32 (28.6)	58 (35.6)	**0.001**
2-3 hours	55 (19.5)	30 (26.8)	25 (15.3)	
4 hours or more	23 (8.2)	16 (14.3)	7 (4.3)	

* *p*-Value based on X2 test, Bold indicates significance p ≤ .05

The intake of food while watching TV and other devices with screens among schoolchildren, stratified by gender has been presented in Table 5. The majority of school children reported the intake of potato chips (33%) and snacks (32.3%) while watching TV and other screens by 2-4 times per week, while the majority reported the intake of ice cream (54%), fried foods (37.6%), fruits or vegetables (35%) and fast foods (46%) while watching TV and other screens by less than once per week. Girls had significantly higher intake of fruits or vegetables while watching TV and other screens viewing than boys (P = 0.004).

Table 5. The intake of food while watching TV and other screens viewing among school children stratified by gender.

The intake of food	**All children *n* (%)**	**Boys *n* (%)**	**Girls *n* (%)**	***P-value***
Which of these meals is usually eaten while watching TV?				
Breakfast	26 (9.2)	10 (8.9)	16 (9.4)	
Lunch	77 (27.3)	37 (33)	40 (23.5)	0.07
Dinner	77 (27.3)	33 (29.5)	44 (25.9)	
Nothing	12 (4.3)	1 (0.9)	11 (6.5)	
All of them	90 (31.9)	31 (27.7)	59 (34.7)	
What is the frequent your child eats any of these food items while watching TV or other devices:				
Potato chips				
Less than once per week	94 (33.3)	39 (34.8)	55 (32.4)	
Once per week	56 (19.9)	23 (20.5)	33 (19.4)	0.85
2-4 times per week	93 (33)	37 (33)	56 (32.9)	
5-6 times per week	12 (4.3)	5 (4.5)	7 (4.1)	
One time per day or more	27 (9.6)	8 (7.1)	19 (11.2)	
Fried foods				
Less than once per week	106 (37.6)	49 (43.8)	57 (33.5)	
Once per week	64 (22.7)	24 (21.4)	40 (23.5)	0.43
2-4 times per week	80 (28.4)	26 (23.2)	54 (31.8)	
5-6 times per week	22 (7.8)	9 (8)	13 (7.6)	
One time per day or more	10 (3.5)	4 (3.6)	6 (3.5)	
Snack foods				
Less than once per week	75 (26.6)	36 (32.1)	39 (22.9)	0.13
Once per week	51 (18.1)	16 (14.3)	35 (20.6)	

2-4 times per week	91 (32.3)	36 (32.1)	55 (32.4)	
5-6 times per week	21 (7.4)	11 (9.8)	10 (5.9)	
One time per day or more	44 (15.6)	13 (11.6)	31 (18.2)	
Ice cream				
Less than once per week	152 (53.9)	67 (59.8)	85 (50)	
Once per week	69 (24.5)	22 (19.6)	47 (27.6)	0.14
2-4 times per week	37 (13.1)	17 (15.2)	20 (11.8)	
5-6 times per week	9 (3.2)	1 (0.9)	8 (4.7)	
One time per day or more	15 (5.3)	5 (4.5)	10 (5.9)	
Fast foods				
Less than once per week	130 (46.1)	47 (42)	83 (48.8)	
Once per week	88 (31.2)	36 (32.1)	52 (30.6)	0.06
2-4 times per week	42 (14.9)	24 (21.4)	18 (10.6)	
5-6 times per week	11 (3.9)	3 (2.7)	8 (4.7)	
One time per day or more	11 (3.9)	2 (1.8)	9 (5.3)	
Fruits or vegetables				
Less than once per week	99 (35.1)	49 (43.8)	50 (29.8)	
Once per week	42 (14.9)	22 (19.6)	20 (11.9)	**0.004**
2-4 times per week	67 (23.8)	24 (21.4)	43 (25.6)	
5-6 times per week	22 (7.8)	6 (5.4)	16 (9.5)	
One time per day or more	50 (17.7)	11 (9.8)	39 (23.2)	

* *p*-Value based on X2 test, Bold indicates significance $p \leq .05$

The associations between the risk of obesity and the factors of watching TV and other devices with screens, physical activity, consumption of snacks while watching TV, and sleep duration has been exhibited in Table 6. Compared to children who played video games or watched videos 1 hour or less per day, children who played video games or watched videos 4 hours or more per day were more likely be obese (OR: 2.7; 95% CI: 1.4–5.4; P = 0.003). Similarly, relative to children who spent 1 hour or less per day using a mobile phone or tablet, those who spent 4 hours or more per day using a mobile phone or tablet were more likely to be obese (OR: 2.1; 95% CI: 1.1–4.2; P = 0.02).

Also, compared to children who were sleeping during weekends for 10 hours or more, those who were sleeping for 6 hours or less were more likely to have obesity (OR: 1.8, 95% CI: 1–3.3, P = 0.04). Moreover, in comparison with children who were always consuming snacks while watching TV, those who were consuming snacks frequently (OR: 0.09, 95% CI: 0.01–0.52, P = 0.008), sometimes (OR: 0.09, 95% CI: 0.01–0.47, P = 0.004), and never consume snacks (OR: 0.13, 95% CI: 0.02–0.73, P = 0.02) were less likely to have obesity.

In addition, compared to children who were never exercise at home, those who were exercising for one hour or less were less likely to have obesity (OR: 0.58, 95% CI: 0.33–1, p = 0.05). Likewise, relative to children who were never exercising outdoors, those who were exercising outdoors for 2-3 hours were less likely to have obesity (OR: 0.39, 95% CI: 0.18-0.85, P = 0.01). There were insignificant associations between risk of obesity and duration of watching TV, sleep duration during weekdays and physical activity at school. There were also insignificant associations between the risk of obesity and the intake of food while watching TV and other

devices with screens, including potato chips, fried foods, ice cream, fast food, and fruits or vegetables (data not shown).

Table 6. TV viewing and other screens viewing among school children stratified by gender.

	Risk of obesity		
	OR	(95% CI)	*P*-value
Duration of watching TV (hours/day) *			
1 hour or less	1		
2-3 hours	.69	(0.37-1.2)	0.23
4 hours or more	1.3	(0.71-2.6)	0.33
Duration of playing video games or watching videos (hours/day) *			
1 hour or less	1		
2-3 hours	1.1	(0.63-2)	0.66
4 hours or more	**2.7**	**(1.4-5.4)**	**0.003**
Duration of time spend on a mobile phone or tablet (hours/day) *			
1 hour or less	1		
2-3 hours	0.81	(0.43-1.5)	0.52
4 hours or more	**2.1**	**(1.1-4.2)**	**0.02**
Consumption of snacks while watching TV*			
Always	1		
Frequently	**0.09**	**(0.01-0.52)**	**0.008**
Sometimes	**0.09**	**(0.01-0.47)**	**0.004**
Never	**0.13**	**(0.02-0.73)**	**0.02**
Sleep duration during weekdays*			
10 hours or more	1		
7-9 hours	1.03	(0.4-2.6)	0.93
6 hours or less	0.8	(0.39-1.7)	0.63
Sleep duration during weekends*			
10 hours or more	1		
7-9 hours	1.4	(0.5-4)	0.54
6 hours or less	**1.8**	**(1-3.3)**	**0.04**
Child exercise at school (hours/week) *			
Never	1		
1 hour or less	0.93	(0.47-1.8)	0.84
2-3 hours	0.66	(0.25-1.6)	0.38
4 hours or more	0.67	(0.18-2.4)	0.55
Child exercise at home (hours/week) *			
Never	1		
1 hour or less	**0.58**	**(0.33-1)**	**0.05**
2-3 hours	0.73	(0.32-1.6)	0.46
4 hours or more	0.21	(0.03-1.2)	0.08
Child exercise outdoor (hours/week) *			
Never	1		

1 hour or less	1.1	(0.61-2.1)	0.67
2-3 hours	**0.39**	**(0.18-0.85)**	**0.01**
4 hours or more	0.48	(0.17-1.3)	0.17

*Bold indicates significance $p \leq .05$, OR = adjusted odds ratio, CI = confidence intervals, *Logistic Regression models after adjustment for age, gender, family income, mother occupation, father occupation, mother education, father education.

4. Discussion

Childhood obesity is a serious medical condition and a global problem. In Saudi Arabia, the combined prevalence of overweight and obesity in children aged 5–18 years old was 34.4% in 2010 [2]. Also, a study of 351,195 Saudi children (2016–2021) reported overweight prevalence at 11.2% and obesity at 9.4%, higher in boys (10.4%) than girls (8.3%) [18]. The findings of the current study showed that the combined rate among elementary school children in Jeddah was 42%, which indicates an increase in the risk of obesity among children over the last decade. This increase is due to many reasons, but some of the most significant and widespread are spending a lot of time watching TV and other screens and a lack of physical activity. Therefore, this study aimed to examine the effect of watching TV and other devices with screens, including smartphones and tablets, on overweight and obesity among Saudi elementary school children in Jeddah. Furthermore, the intake of food while watching TV and other devices with screens was investigated, as were lifestyle behaviours, such as physical activity and sleep duration.

The results of the current study revealed that the prevalences of overweight and obesity among boys were 20.5% and 28.6%, respectively, while those among girls were 17.1% and 20.6%, respectively. Approximately 42% of the sample were at risk of obesity (combined overweight and obesity), with boys having a significantly higher risk (49.1%) than girls (37.6%) ($P < 0.05$). In comparison, a national study conducted in Jeddah in 2016 among 915 elementary school children reported that overweight was higher among girls (19%) than boys (17%), while obesity was higher among boys (20%) than girls (16%) [19]. In a study conducted in Jeddah in 2020, among 200 children (118 boys and 82 girls) aged 5-15 years old, obesity was higher in boys than girls [20], which is consistent with this study findings. Also, the results of a study conducted in Pakistan in 2022 among 200 children aged 5–15 years showed that obesity was higher among boys (54%) than girls (46%) [21]. In a study of Japanese children aged 9–10 years, overweight was more common in boys (58.2%) than girls (41.8%) [22]. However, in a study conducted in Nairobi, Kenya, in 2018 among 563 children aged 9–11 years, girls were overweight (56.6%) more than boys (50.8%) [23].

In the current study, boys were more likely to have mobile phones and TVs in their bedrooms and to play video games than girls. In addition, boys spend longer amounts of time watching TV than girls. At the same time, girls were reported to sleep longer on weekends and consume more fruit and vegetables while watching TV than boys. All these factors may explain boys' significantly higher risk of obesity. International evidence has illustrated the association between the use of electronic devices and watching TV and an increased risk of obesity in children. Indeed, one study showed that a higher BMI in obese children was associated with more hours spent watching TV [24]. Moreover, a Chinese study demonstrated the impact of watching TV on weight gain and obesity in children aged 4–5 years [25]. Another study showed that time spent watching TV in childhood and adolescence was associated with metabolic syndrome in mid-adulthood [26].

The present study reported that two-thirds of schoolchildren had 2 or fewer TVs at home and had their own mobile phones. Also, more than half had their own tablets. A study conducted in

2012 among several European populations showed that the percentage of boys who had a TV in their bedroom (33.5%) was higher than that of girls (30.9%) and that boys spent more time watching TV (47.1%) than girls (42.8%) [27]. Similarly, a national study conducted in 2016 in Jeddah among schoolchildren reported that boys spent more time watching TV and using electronic devices than girls (15.1% vs. 10.9% and 9.5% vs. 6.3%, respectively) [19]. A Portuguese study conducted in 2020 among 6,033 children aged 6–10 years also found that boys spent significantly more time per day using devices with screens than girls [28]. In Saudi Arabia, the Ministry of Health recommends that children not exceed two hours per day on electronic devices and that parents ensure that the time spent using electronic devices does not interfere with children's getting enough sleep and performing physical activity [29].

The findings of the current study showed that the majority of the schoolchildren slept for 7–9 hours on weekdays and weekends, with girls sleeping significantly longer on weekends than boys. A study in Pakistan showed that 60% of children aged 5–15 years slept more than 9 hours per day, which is more than reported in this study [21]. In a national study conducted in Riyadh in 2019 among 1,051 elementary school students, the average duration of sleep was 8.14 hours per night, with girls sleeping significantly longer on weekends compared to boys [30], a finding similar to ours. A study conducted in Chicago on 308 children aged 4–10 years also showed similar results: the children slept an average of 8 hours per night [31]. In a Chinese study conducted in 2022, the results showed that girls had significantly better sleep quality scores than boys, but no significant differences were observed between the gender in terms of sleep duration [32]. Likewise, in a study conducted among 10 European countries in 2021, there was no significant difference in sleep duration between boys and girls [33]. The Ministry of Health in Saudi Arabia found that 9–11 hours are recommended for healthy sleep in children aged 6–12 years [34]. However, the current study found that children aged 6–13 years sleep 7–9 hours on weekdays and weekends on average, which is less than the recommendation. Future studies should focus on the factors contributing to insufficient sleep and develop awareness programs to improve sleep habits. Parents should establish a consistent bedtime routine, reduce screen time before sleep, and provide a comfortable sleep environment to ensure children get adequate rest.

The current study showed that children exercise in school (62.4%), at home (44.7%), and outdoors (31.9%) for 1 hour or less per week, with boys being significantly more physically active than girls in school ($P < 0.02$) and outdoors ($P < 0.001$). International studies have reported similar results. In a Pakistani study conducted in 2010 among elementary school students 5–12 years old, boys were found to be more active than girls [35]. Similarly, in a study conducted in England in 2010, among children aged 7 years, girls exhibited a significant increase in sedentary behaviour compared to boys [36]. Also, in a Brazilian study conducted among 616 children aged 8 years, inactivity rates were higher in girls (75.3%) than in boys (67.4%) [37].

The Saudi Ministry of Health recommends that children aged 5–17 years should practice physical activity 60 minutes a day 3 times per week to defend against obesity and strengthen bones and muscles. Although the current study's results are far below this recommendation [38], 68.8% of parents believed their children were physically active, which indicates that more education and outreach are needed on this issue.

Our results showed insignificant associations between a child's gender and the intake of specific food, such as potato chips, fried food, snacks, ice cream, and fast food, while watching TV and other devices with screens. However, we found that girls consumed significantly more vegetables and fruit while watching TV and other devices with screens than boys. Several prior

studies have shown that children consume large amounts of unhealthy food while watching TV [39–41]; however, this is contradictory to the results of our study, as the intake of food while watching TV was small. This may be due to the allocation of eating while watching TV, or the food groups we specified in the survey resulted in information being underreported by the parents.

In 2011, the European Youth Heart Study revealed that more TV viewing (hours/day) was associated with less intake of healthy food among girls and boys aged 8–16 years [39]. Also, a study of children in five European countries aged 6–9 years found associations between time spent watching TV and other devices with screens and an increased consumption of foods rich in fats and sugars (e.g. soft drinks, potato chips, corn chips, candy bars, chocolate, cakes, doughnuts and French fries) and a lower intake of fruits and vegetables [40]. Similarly, a study conducted in the United States in 2019 among children aged 5–7 years revealed that watching TV during meal consumption was associated with increased intake of unhealthy food groups, such as sugar-sweetened beverages, chips and crackers, and decreased intake of fruits [41].

One study conducted in Saudi Arabia in 2017 among children aged 5–12 years found that obese children used electronic devices an hour per day more on average than non-obese children [41]. The study also showed that obese children consumed more chocolate and fewer vegetables and fruits than non-obese children [42]. In the current study, there was a significant association between the consumption of snacks while watching TV and the risk of obesity. In line with these results, a Canadian study in 2009 conducted among fifth-grade children reported that those with a higher frequency of eating in front of the TV were 1.43 times more likely to be overweight [43]. However, a similar national study conducted in 2013 among children aged 9–14 years found no significant association between eating while watching TV and obesity [44]. Another national study conducted in 2015 among 541 children showed no significant association between the duration of watching TV and obesity [45], a result similar to this study's findings.

However, the current study found a significant association between duration of playing video games, watching videos and time spent on mobile phones or tablets and the risk of obesity. Similarly, a Brazilian study reported that watching TV for more than two hours daily was positively associated with excess weight gain [38]. Also, a Canadian study found that both watching TV and eating while watching TV were positively and independently associated with weight gain [43]. Furthermore, a national study in 2013 indicated that obesity was significantly associated with watching TV for more than 3 hours per day on the weekend, eating more than three snacks per day and watching TV at night [44]. Another national study in 2017 showed that physical inactivity and watching TV were major risk factors for obesity among Saudi schoolchildren and adolescents [46]. Also, a study conducted in United States in 2019, report that watching TV at least 4 hours daily at ages 3–10 years was related to 25%–61% higher odds of overweight/obesity throughout life [47]. Similarly, a cross-sectional study conducted in southeast Poland in 2022 among 376 children aged 6-15 years, found that children who spend more time using smartphone and sleep less hours had higher risk of obesity [48].

In the current study, there was no significant association found between sleep duration during the week and the risk of obesity, but there was a significant association between sleep duration on weekends and the risk of obesity. In a study conducted in the United States, the sleep duration of children of normal weight was regular during the weekdays and longer on the weekend; however, obese children slept less on weekends [31]. In addition, a European study found that one additional hour of sleep was associated with an increased consumption of fresh fruits and vegetables [40]. Another study showed that children who spent fewer hours sleeping had more caloric intake in the

morning. Moreover, children's sleeping time was affected by the time they spent watching TV and playing video games [49]. Likewise, a study conducted in China in 2022 reported that, in children aged 6–13 years, short sleep duration (7–8 hours) was significantly associated with overweight and obesity compared to the recommended sleep duration (9–11 hours) [32].

Finally, the current study showed a significant inverse association between the risk of obesity and physical activity outdoors and at home. A study conducted in Pakistan in 2010 showed that physical activity more than twice a week was significantly associated with a decreased risk of overweight and obesity in both gender (P = 0.001) [35]. Likewise, a multi-national study in 2015 including children aged 9–11 years reported that there was not only a significant inverse association between moderate-to-vigorous and vigorous physical activity and obesity but also a significant positive association between sedentary behaviour and obesity [50]. Also, a Saudi study in 2016 among 145 children aged 10–15 years showed that while there was a significant inverse association between physical activity and obesity among boys, there was no significant association among girls [51].

The present study has several strengths. First, the study data was collected using validated questionnaires. Second, the sample size was both representative of children in Jeddah and proportionate between boys and girls. Third, the survey included several factors that may affect obesity in children. Finally, because this study collected data on devices with screens and screen time other than watching TV, it estimates the true use of electronic devices.

However, this study also has several limitations. First, because of the cross-sectional study design, causal relationships cannot be achieved. Second, the questionnaire had some questions that required remembrance; hence, recall bias may have been introduced. Third, a lack of awareness from parents about their children's TV viewing habits, the desire to please, and possible unwillingness to tell the truth might have affected the results. Moreover, the height and weight data were self-reported by parents and not measured by principal investigator, which may have resulted in reporting errors, as under- or overestimations may have occurred. Lastly, the generalisability of the results is limited because the survey sample was representative of Jeddah only.

5. Conclusion

The present study assessed the prevalence of overweight and obesity and examined the association of TV viewing and other screens viewing, such as (video viewing, video games, smartphones and tablets), physical activity, and sleep duration with the prevalence of overweight and obesity among elementary school children aged 6-12 years old in Jeddah. The study findings revealed that a high percentage of elementary school children are at risk of obesity. Although there was no significant association between watching TV and obesity in children, the results showed that the time spent watching other screens, such as watching videos on tablets, was significantly associated with obesity in children. In addition, the results showed a general lack of physical activity among elementary school children. These findings call for the implementation and development of national programmes for the prevention of obesity in children in Saudi Arabia. These programmes should include strategies to reduce children's use of electronic devices as well as improve sleep duration and diet at home and nutrition and physical education at school.

The results of the current study have crucial implications for potential strategies to reduce the prevalence of overweight and obesity in children. Such strategies will also decrease the prevalence

of many obesity-related noncommunicable diseases that can burden a nation's society and economy. Fighting obesity early in childhood thus decreases the cost of obesity and its treatment, as well as improves public health overall.

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ارتباط السمنة بمشاهدة التلفاز والشاشات الأخرى، والنشاط البدني، وتناول الطعام بين طلاب المدارس الابتدائية في جدة، المملكة العربية السعودية.

بشرى شجون*[1،*] و نجلاء الجفري[1]

[1]قسم الغذاء والتغذية، مبنى ٤٣، غرفة ١١١، الطابق الأول، كلية علوم الإنسان والتصاميم، جامعة الملك عبدالعزيز، جدة، ٣٢٧٠، المملكة العربية السعودية.

*للمراسلة: البريد الإلكتروني bshojoon0001@Stu.kau.edu.sa

الملخص:

ارتفع انتشار السمنة لدى الأطفال بشكل كبير على مستوى العالم. تُعد مشاهدة التلفاز واستخدام الأجهزة الأخرى ذات الشاشات من العوامل المساهمة في إنتشار السمنة. شملت هذه الدراسة ٢٨٢ طفلًا من تلاميذ المدارس الابتدائية الذين تتراوح أعمارهم بين ٦ –١٣ عامًا في المدارس الحكومية والأهلية بمدينة جدة. تم توزيع استبيان إلكتروني على المدارس لجمع البيانات المتعلقة بالخصائص الاجتماعية والديموغرافية، الطول، الوزن، وقت مشاهدة الشاشات، مدة النوم، والنشاط البدني. بلغت نسبة زيادة الوزن ١٨,٤% بينما بلغت نسبة السمنة ٢٣,٨% وكان الأولاد أكثر عرضة للسمنة بشكل ملحوظ (٤٩٪) مقارنةً بالبنات (٣٧,٦٪)($P < 0.05$) . أظهرت النتائج أن غالبية الأطفال يمتلكون هاتفًا محمولًا خاصًا بهم (٧٧٪) ولديهم جهاز لوحي (تابلت) خاص بهم (٥٦٪). كما أن أكثر من ثُلث الأطفال يقضون ٢–٣ ساعات يوميًا في مشاهدة التلفاز و/أو الأجهزة الأخرى. الأطفال الذين يلعبون ألعاب الفيديو أو يشاهدون مقاطع الفيديو لمدة ٤ ساعات أو أكثر يوميًا كانوا أكثر عرضة للإصابة بالسمنة. وبالمثل، كان الأطفال الذين يقضون ٤ ساعات أو أكثر يوميًا باستخدام الهاتف المحمول أو الجهاز اللوحي أكثر عرضة للسمنة. كما أن الأطفال الذين ينامون ٦ ساعات أو أقل كانوا أكثر عرضة للسمنة. أما الأطفال الذين يمارسون الرياضة لمدة ساعة أو أقل فكانوا أقل عرضة للسمنة مقارنةً بمن لا يمارسون الرياضة إطلاقًا. تشير هذه النتائج إلى ضرورة تنفيذ برامج وطنية تهدف إلى تقليل استخدام الأطفال للأجهزة الإلكترونية وتحسين سلوكيات نمط الحياة للحد من انتشار السمنة بين الأطفال في المملكة العربية السعودية.

الكلمات المفتاحية:

السمنة، النشاط البدني، مشاهدة الشاشات، مشاهدة التلفاز، تلاميذ المرحلة الابتدائية، المملكة العربية السعودية.