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# The Prevalence of Obesity among School Students and its Relation to Dietary and Physical Habits

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## Abstract

**BACKGROUND:** Recent studies suggest that unhealthy food practices and lack of exercise are the main cause of the progressive increase in the obesity prevalence.

**AIM:** We aim to assess the prevalence of obesity among school students and its relationship to dietary and physical habits.

**METHODS:** A cross-sectional study from 18 intermediate and high schools located in Taif, Saudi Arabia, between April 2014 and June 2015. We excluded any student with a psychological disease or chronic diseases. We calculated the body mass index (BMI) of students by measuring their height and weight. Dietary, physical, sleep habits, and socioeconomic status were assessed.

**RESULTS:** A total of 2943 students participated with a mean age of  $15.4 \pm 1.7$  years. The majority of these were boys and attending government schools with a mean BMI  $22.7 \pm 8.6$  kg/m<sup>2</sup>. Overall, 13.6% were overweight and 12.8% were obese. One-third of students report a sedentary lifestyle. Compared to girls, boys were more likely to have lower BMI ( $p < 0.001$ ), be overweight ( $p < 0.001$ ), exercise for  $>300$  min/week ( $p < 0.001$ ), own electronic devices other than smartphone ( $p < 0.001$ ), use the electronic devices  $<3$  h/day ( $p = 0.007$ ), eat their meals with their family ( $p < 0.001$ ), eat fruits and vegetables daily ( $p < 0.05$ ), exercise for  $>300$  min/week ( $p < 0.001$ ), and walk to and from school at least once weekly ( $p < 0.001$ ).

**CONCLUSION:** A quarter of the students were either overweight or obese. Girls were more likely to be obese with less favorable socioeconomic, media consumption, dietary, and physical profiles.

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## Introduction

Overweight and obesity are defined as an abnormally accumulated excess fat that might impair health. Obesity is associated with many chronic diseases, including diabetes mellitus (DM), hypertension, and cardiovascular diseases [1]. The World Health Organization (WHO) has reported that worldwide obesity has increased by 300% since 1975 and, in 2016, about 2 billion adults were overweight and about 650 million of them are considered obese [2]. Nationally, a study showed that around 28% of the participants were obese with a body mass index (BMI) of  $\geq 30$  kg/m<sup>2</sup>, with women having a higher obesity prevalence (by 9%) compared to men [3].

Obesity has been associated with socioeconomic status and lifestyle habits in both genders [4]. Many factors contribute to the progressive increase of obesity prevalence with nutrition being considered the most important factor [5]. Increased carbohydrates intake is associated with weight gain [6]. There is evidence that sugary drinks are a significant cause of gaining extra weight. Overweight

children are more likely to drink sugary drinks daily [7]. Furthermore, sugary drinks are associated with many chronic diseases, including DM [8]. One study reported that those who consumed three soft drinks per day or more, including diet soft drinks, had higher BMI, had more body fat, and were more likely to have BMI that is consistent with being overweight in children [9]. A recent cohort study has shown that people who consume more whole grain fibers have lower body weight than those who consumed less whole grain fiber [10]. Women in the group with the highest intake of dietary fiber intake had only about 50% risk of major weight gain [10]. Daily vegetable and fruit consumptions are also an important factor in fighting obesity epidemics [11].

Television and advertisement exposure increase soft drink consumption among children and increase unhealthy food practices [12]. Regardless of macronutrients, a low-calorie diet for 6 months results in an average weight loss of 7% [13]. Many cross-sectional studies have shown that smokers have a higher waist-to-hip ratio than non-smokers [14], [15]. Furthermore, smokers who quit smoking usually experience weight gain as a cohort study showed that over 10 years after smoking cessation, mean weight gain for males was

2.8 kg, compared to 3.8 kg for females [16]. There is clear evidence that physical activity is an important factor for healthy weight as a recent study showed that those who perform moderate to vigorous exercise were more likely to have lower BMI and waist circumference [17]. A recent study has shown that overweight children were significantly less likely to participate in vigorous exercise compared to those who are not overweight [17]. Elementary school boys who walk or bike to school a few days a week tend to have lower BMI and skin folds than those who do not [18].

There are limited data locally about the prevalence of obesity and its relation to lifestyle habits. Our primary goal is to assess the prevalence of obesity among schoolchildren and its relationship to dietary and physical habits.

## Method

This is a cross-sectional study that gathered data from intermediate and secondary school students in Taif, Saudi Arabia. This study was conducted in the period between April 2014 and June 2015. We excluded any student with mental retardation, non-communicable disease, or psychological diseases. We randomly selected 18 schools, all of which were public schools, except two that were private. This study was approved by the research ethical committee at Taif University with an approval number of 39-36-0037.

We chose one or two classes in a random way from every school that we visited. We calculated the BMI of every student by measuring their height and weight. We classified BMI following the WHO classification, as follows:  $<18.5 \text{ kg/m}^2$  is underweight,  $18.5\text{--}24.9 \text{ kg/m}^2$  is normal,  $25\text{--}29.9 \text{ kg/m}^2$  is overweight, and obese for the BMI of  $\geq 30 \text{ kg/m}^2$ .

The personal data were collected by interviewing each student, and the researchers completed the questionnaire. The questionnaire was initially validated in one school before a data collection phase to ensure accuracy. Researchers spoke to the students directly, explained the purpose of the study, and gained a verbal consent from them.

We inquired about the students' socioeconomic status, including living with parents, owning a home, and parents work and educational status. We also inquired about the time spent using electronic devices.

We inquired data the students' sleeping period; we considered the optimal sleeping period to be 6–8 h. We inquired if the student takes a nap regularly and its duration. Furthermore, we gathered data about how regular they eat breakfast and how often students eat their meals with their families versus eating outside. Furthermore, we inquired about eating healthy foods,

such as fruits and vegetables, and unhealthy foods such as potato chips and pastries. We also inquired about their physical activity habits and smoking habits.

Data were collected and analyzed using the SPSS software. The Chi-squared test was used to study the relationship between variables, and the *t*-test was used to compare between means.

## Results

A total of 2943 students participated with a mean age of  $15.4 \pm 1.7$  years, and most of them were boys and attending government schools with a mean BMI of  $22.7 \pm 8.6 \text{ kg/m}^2$  (Table 1). Overall, 13.6% were overweight and 12.8% were obese. Most of the students lived with their parents who own their houses. Student's fathers were the source of the family income in most of the cases. The smartphone was the most commonly owned electronic device. Most of the participants used electronic devices for less than 3 h/day and at bedtime. One-third of the students considered to have short sleep duration and to practice daily reading. One-third of the student's report taking a nap on a regular basis, but most of them spent more than 1 h/nap. Most of the respondents eat breakfast regularly, eat their meals with their family, and watched television while eating. One-fifth of the students eat fruits, vegetables, and/or drink milk daily. One-third of them report sedentary lifestyle and similarly were active for 150 min/week or less. Heavy lifting and group exercise were the most common forms of exercise practiced. Car was the most common transportation mode used by the students. Few of the students were active smokers, but close to half reported being passive smokers.

More than two-thirds of the sample were boys (Table 2). Compared to girls, boys were more likely to be older ( $p < 0.001$ ), were intermediate students ( $p < 0.001$ ), have lower BMI ( $p < 0.001$ ), have higher waist circumference ( $p < 0.001$ ), to be overweight ( $p < 0.001$ ), live with both parents ( $p < 0.001$ ), have working parents ( $p < 0.001$ ), own electronic devices other than smartphone ( $p < 0.001$ ), use the electronic devices  $<3 \text{ h/day}$  ( $p = 0.007$ ), have a television in their bedroom ( $p < 0.001$ ), watch television for less than 3 h ( $p < 0.001$ ), play video games and for a duration of  $>3 \text{ h/day}$  ( $p < 0.001$ ), eat their meals with the family ( $p < 0.001$ ), eat from restaurants ( $p < 0.001$ ), eat fruits and vegetables daily ( $p < 0.05$ ), drink soda and milk daily ( $p < 0.05$ ), exercise for  $>300 \text{ min/week}$  ( $p < 0.001$ ), participate in group exercise and attending the gym ( $p < 0.001$ ), use a car for school transportation ( $p < 0.001$ ), walk to and from school at least once weekly ( $p < 0.001$ ), longer duration of active smoking ( $p < 0.001$ ), and to be passive smokers ( $p < 0.001$ ). Compared to girls, boys were less likely to be obese ( $p < 0.001$ ), practice daily reading ( $p < 0.001$ ), eat breakfast at home ( $p < 0.001$ ),

**Table 1: Baseline characteristics of the whole cohort**

Baseline characteristics (n=2943)	
Mean age (years)	15.4±1.7
Boy (%)	77.2
Intermediate school students (%)	52.7
Study at governmental school (%)	85.3
Mean weight (kg)	61.3±25.3
Mean BMI (kg/m <sup>2</sup> )	22.7±8.6
Mean waist circumference (cm)	77.3±17.3
Overweight (%)	12.8
Obese (%)	13.6
Socioeconomic	
Older sibling (%)	30.9
Live with both parents (%)	85.0
Own their houses (%)	59.4
Father work only (%)	67.6
Both parents work (%)	26.3
Father with bachelor's degree or higher (%)	51.1
Mother with bachelor's degree or higher (%)	41.5
Media consumptions habits	
Own personal smartphone (%)	76.2
Own personal laptop (%)	6.3
Own personal tablet (%)	12.7
Own personal home computer (%)	4.8
Electronic devices usage <3 h/day (%)	41.8
Electronic devices usage >6 h/day (%)	28.5
Use of the electronic devices at bedtime (%)	64.7
Television in the bedroom (%)	42.9
Watch television <3 h/day (%)	71.4
Daily use of video games (%)	26.6
Play video games >3 h/day (%)	32.6
Sleep/reading habits	
Sleep 6–8 h/night (%)	41.9
Sleep less than 6 h/night (%)	33.6
Regular nap (%)	42.1
Mean nap time <30 min/day (%)	18.1
Mean nap time >60 min/day (%)	56.4
Practice daily reading (%)	32.8
Duration of daily reading is 1–3 h/day (%)	21.1
Diet habits	
Eat breakfast at home (%)	38.4
Eat breakfast regularly (%)	67.8
Eat launch with family most of the time (%)	86.1
Eat dinner with family most of the time (%)	84.7
Rarely eat food from restaurant (%)	14.6
At least eat once daily from restaurant (%)	23.3
Eat fruits at least once daily (%)	18.2
Eat vegetable at least once daily (%)	20.6
Eat desserts and/or chocolates at least once daily (%)	25.8
Eat potato chips at least once daily (%)	16.7
Eat pastries at least once daily (%)	11.7
Drink soda at least once daily (%)	34.3
Drink milk at least once daily (%)	26.3
Eat from fast-food chains at least once daily (%)	6.5
Watch television while eating (%)	67.9
Physical activity	
Sedentary lifestyle (%)	38.3
Exercise <150 min/week (%)	32.6
Exercise >300 min/week (%)	15.1
Routine heavy lifting exercises (%)	41.6
Routine group exercises (%)	43.4
Routine walking exercises (%)	33.1
Transportation	
Walk to/from school at least once/week (%)	38.0
The mean number of days you walk to/from school (days)	3.7±3.4
Use car transportation to/from school (%)	63.7
Use bus transportation to/from school (%)	6.6
Smoking	
Active smoker (%)	8.6
Duration of active smoking (years)	1.4±1.2
Number of packs of cigarettes smoked per day	2.3±1.5
Passive smoker (%)	44.8

eat desserts and/or potato chips daily ( $p < 0.001$ ), eat pastries daily ( $p = 0.002$ ), eat from fast-food chains ( $p = 0.005$ ), watch television while eating ( $p < 0.001$ ), report sedentary lifestyle ( $p < 0.001$ ), and use a bus for school transportation ( $p < 0.001$ ).

Adjusted for age, gender, school grade, school type, parent's educational level, parent's employment status, living situation, and ranking among siblings, we detected significant positive correlations between owning smartphones and both BMI and waist circumference, eating lunch with family and waist circumference, and eating dinner with family and both BMI and waist circumference (Table 3). We also

**Table 2: Groups based on the gender of the participants**

Groups	Boys	Girls	p value
Participants number (%)	77.2	22.8	n/a
Mean age (years)	15.5±1.7	15.1±1.7	<0.001
Intermediate school students (%)	48.9	65.4	<0.001
Study at governmental school (%)	81.1	100	<0.001
Mean weight (kg)	59.3±19.7	68.0±37.9	<0.001
Mean BMI (kg/m <sup>2</sup> )	22.0±6.2	25.2±13.4	<0.001
Mean waist circumference (cm)	78.5±14.4	73.2±24.1	<0.001
Overweight (%)	15.0	9.1	
Obese (%)	10.8	19.9	<0.001
Socioeconomic			
Older sibling (%)	29.7	35.2	0.020
Live with both parents (%)	86.6	78.8	<0.001
Own their houses (%)	59.4	59.3	0.059
Father work only (%)	68.4	65.3	
Both parents work (%)	26.8	24.5	<0.001
Father with bachelor's degree or higher (%)	49.8	51.1	<0.001
Mother with bachelor's degree or higher (%)	40.3	45.6	0.053
Media consumptions habits			
Own personal smartphone (%)	73.9	84.0	
Own personal laptop (%)	7.0	3.8	
Own personal tablet (%)	13.2	11.2	<0.001
Own personal home computer (%)	5.9	1.1	
Electronic devices usage <3 h/day (%)	42.2	40.5	
Electronic devices usage >6 h/day (%)	27.0	33.5	0.007
Use of the electronic devices at bedtime (%)	64.8	64.5	0.026
Television in the bedroom (%)	46.8	29.8	<0.001
Watch television <3 h/day (%)	73.0	66.1	0.001
Daily use of video games (%)	31.0	11.8	<0.001
Play video games >3 h/day (%)	35.5	23.6	<0.001
Sleep/reading habits			
Sleep 6–8 h/night (%)	42.8	38.7	0.140
Sleep <6 h/night (%)	33.3	34.5	
Regular nap (%)	41.0	45.6	<0.001
Mean nap time <30 min/day (%)	18.4	16.9	0.759
Mean nap time >60 min/day (%)	56.0	57.7	
Practice daily reading (%)	32.5	33.9	<0.001
Duration of daily reading is 1–3 h/day (%)	18.6	29.5	<0.001
Diet habits			
Eat breakfast at home (%)	38.2	39.0	<0.001
Eat breakfast regularly (%)	72.2	52.0	<0.001
Eat launch with family (%)	88.5	78.0	<0.001
Eat dinner with family (%)	85.9	80.8	<0.001
Rarely eat food from restaurant (%)	14.3	15.4	<0.001
At least eat once daily from restaurant (%)	25.9	14.8	<0.001
Eat fruits at least once daily (%)	19.8	12.5	<0.001
Eat vegetable at least once daily (%)	22.1	15.7	0.009
Eat desserts and/or chocolates at least once daily (%)	21.6	40.3	<0.001
Eat potato chips at least once daily (%)	14.7	23.6	<0.001
Eat pastries at least once daily (%)	11.4	12.6	0.002
Drink soda at least once daily (%)	35.8	29.2	0.019
Drink milk at least once daily (%)	29.3	16.0	<0.001
Eat from fast-food chains at least once daily (%)	5.8	8.9	0.005
Watch television while eating (%)	67.1	70.7	<0.001
Physical activity			
Sedentary lifestyle (%)	37.2	42.2	
Exercise <150 min/week (%)	30.8	38.6	<0.001
Exercise >300 min/week (%)	17.9	5.7	
Routine heavy lifting exercises (%)	51.0	6.8	
Routine group exercises (%)	47.6	27.6	<0.001
Routine walking exercises (%)	23.5	68.7	
Transportation			
Walk to/from school at least once/week (%)	39.3	33.9	<0.001
The mean number of days you walk to/from school (days)	3.7±3.7	3.8±2.4	0.733
Use car transportation to/from school (%)	67.0	52.4	
Use bus transportation to/from school (%)	3.01	18.5	<0.001
Smoking			
Active smoker (%)	8.4	9.3	0.131
Duration of active smoking (years)	2.8±1.7	1.49±0.5	<0.001
Number of packs of cigarettes smoked per day	1.4±1.2	3.3±2.1	0.006
Passive smoker (%)	48.1	33.7	<0.001

detected a significant negative correlation between eating pastries and BMI.

## Discussion

We should note that around 25% of the participants in our study were either overweight or



**Table 3: Partial correlation after adjusting for age, gender, school grade, school type, parents' educational level, parent's employment status, living situation, and ranking among siblings**

Groups	BMI	Waist circumference
Own personal smartphone	r 0.070 p 0.042*	r 0.075 p 0.028*
Use of the electronic devices at bedtime	r -0.022 p 0.519	r -0.005 p 0.876
Television in the bedroom	r 0.026 p 0.447	r 0.012 p 0.717
Daily use of video games	r 0.011 p 0.755	r 0.006 p 0.860
Regular nap	r 0.000 p 0.994	r -0.002 p 0.962
Practice daily reading	r -0.001 p 0.983	r -0.046 p 0.184
Eat breakfast regularly	r 0.045 p 0.190	r 0.003 p 0.935
Eat breakfast at home	r 0.004 p 0.913	r 0.016 p 0.632
Eat launch with family	r 0.051 p 0.137	r 0.087 p 0.011*
Eat dinner with family	r 0.100 p 0.004*	r 0.075 p 0.029*
At least eat once daily from restaurant	r 0.045 p 0.192	r 0.042 p 0.223
Eat fruits at least once daily	r -0.008 p 0.817	r 0.007 p 0.847
Eat vegetable at least once daily	r 0.013 p 0.706	r 0.035 p 0.303
Eat desserts and/or chocolates at least once daily	r -0.034 p 0.320	r -0.008 p 0.813
Eat potato chips at least once daily	r -0.036 p 0.299	r -0.035 p 0.310
Eat pastries at least once daily	r -0.072 p 0.035*	r -0.017 p 0.631
Drink soda at least once daily	r -0.008 p 0.810	r -0.033 p 0.331
Drink milk at least once daily	r 0.011 p 0.745	r -0.002 p 0.951
Eat from fast-food chains at least once daily	r -0.030 p 0.388	r -0.031 p 0.365
Exercise minutes/week	r -0.059 p 0.083	r -0.053 p 0.127
Active smoker	r 0.054 p 0.116	r 0.007 p 0.848
Passive smoker	r -0.022 p 0.530	r -0.004 p 0.906

\*p ≤ 0.05, \*\*p &lt; 0.001

obese. A recent study from the northern region of Saudi Arabia and involving a similar age population also reported an overweight or obese prevalence of 25% [19]. Another study from Ethiopia showed a similar prevalence of overweight among adolescents but lower obesity prevalence compared to our study [20]. A systemic review showed that, in the USA, the prevalence of obesity and overweight was around 28%, which is similar or slightly higher than what we report in our study [21]. These similarities suggest that our findings are likely to be broadly transferable.

In our study, 76.2% of the students reported owning a personal smartphone; when we adjusted for common confounders, there was a significant positive correlation between owning a smartphone and both waist circumference and BMI. South Korea, followed by Australia and the US, is the country with the highest percentage of owning a smartphone (72–80%) [22]. A recent study showed that smartphone usage correlated with been overweight or obese [23]. This relationship is most likely explained by a reduction in physical activity; as a recent meta-analysis showed that using smart devices properly increase the physical activities to facilitate weight loss [24].

In the adjusted analysis, in our study, eating dinner and lunch with family were associated with worse body

fat measures. An earlier larger study showed that eating meals with the family were protective against obesity and resulted in better nutritional status [25]. These different findings could be related to cultural differences, as well as differences in mealtimes and the mothers' educational status. Such cultural differences and maternal educational influence were obvious in a recent publication [26].

Girls in our study were more likely to be obese, while boys were more likely to be overweight. This is consistent with a previous large community-based study done in Saudi Arabia in an older age group [27]. Our finding can likely be explained by several socioeconomic, media, nutritional, and activity variables. For example, girls were more likely to own a smartphone but were less likely to own a computer and laptop, in addition to boys spending less time daily on electronic devices. A recent study from the Western region of Saudi Arabia showed a positive relationship between the time spent using electronic devices and BMI [28]. Furthermore, our study girls were less likely to eat fruits and vegetables but were more likely to eat potato chips and fast food frequently compared to boys. A recent study suggested that increasing fruits and vegetable consumption helps to overcome obesity epidemics [29]. Interestingly, a comparative study showed more hunger and less satisfaction with potato chips [30]. Our study showed that girls were more likely to report a sedentary lifestyle and were less likely to be involved in group exercise and to walk to and from school. Similar findings were reported in a study done in Brazil, where girls were more likely to report a sedentary lifestyle [31]. A Japanese study showed that walking to school can help combat obesity [32].

Our study's strengths include the large sample size and comprehensive analysis of the related variables. Limitations of our study are that it involves only a single city, that girls were relatively underrepresented, and that there is a possibility of recalls bias. Another limitation is that obesity may occur because of the excess energy intake or lower energy expenditure and our research does not take account for the energy intake.

## Conclusion

A quarter of the students were either overweight or obese. Compared to the boys, the girls were more likely to be obese and had less favorable socioeconomic, media consumption, dietary, and physical profiles.

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