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Lifestyle and its Association with Obesity and Overweight Among Students in Saudi Arabia

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A B S T R A C T

Background: Childhood obesity is considered a globally pandemic. The primary cause of overweight and obesity is lifestyle that leads to the energy imbalance between consumed calories and expended ones. **Objective**: Therefore, this study aimed to assess lifestyle and its relation to obesity among schoolchildren in Saudi Arabia. **Method**: a cross-sectional study was conducted among adolescents during November 2019 and February 2020 all over Saudi Arabia. Data was collected through a self-administered questionnaire including socio-demographic characteristics, dietary habits, and lifestyle. The weight, height, and the body mass index of was documented to the participants. Prevalence of obesity was assessed, and risk factors were determined. **Results**: Out of 1,396 participants, 81.2% completed the questionnaires, their mean age was 14.18±2.33 years, and 54.5% were females. The prevalence of overweight and obesity was 15.9% and 12.8%, and underweight was 13.5%. The main predictors that were significantly associated with overweight and obesity were a positive family history of obesity, consuming French fries ≥ 3 days /week, and consuming milk products less than twice daily. However, surprisingly, children not gathering during eating food with family, consuming fast food ≥ 3 days /week, or eating fast food at home were found to be associated with lower prevalence of overweight and obesity. **Conclusion**: Overweight and obesity prevalence is still high among students, especially those who have a positive family history of obesity, obesity at younger age, consuming more French fries weekly, and less milk products daily. Therefore, we need urgent and effective policies and interventions to combat schoolchildren obesity.

INTRODUCTION

Childhood obesity is a serious global pandemic, over 340 million children and adolescents (nearly 18%) were overweight or obese in 2016.[1] Obesity accounts for billions of dollars in the provision of healthcare[1,2] therefore, the management of children obesity is considered a public health priority.[1]

Children with obesity will undoubtedly be continue during adult stage. This exposes them to many health

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problems at an early age and decreases their quality of life with many psychological and social problems like depressive symptoms, suicidal ideation, bullying, low self-esteem, discriminatory experiences, and they are less socially accepted.[3-5]

The high availability and accessibility of energy-dense foods and lack of restrictive policies lead to an increase in the consumption of these foods and the increase in the calories consumed.[2] Adding to physical inactivity will lead to an energy imbalance between calories consumed and calories expended. This unhealthy lifestyle is considered the primary cause of overweight and obesity, especially among youth.[6]

As for eating behaviors and habits formed during childhood persist into adulthood,[7] so interventions to improve child dietary intake are recommended as a key strategy in reducing the future burden of chronic diseases.[8] Schools are recommended as a relevant setting to improve children's dietary intake as they provide access to almost all children during a key developmental period. [9] Community-based combined diet and physical activity interventions engaging the schools are the most effective on obesity and overweight control. Therefore, world health organization (WHO) recommends establishing standards for meal provision to fulfill nutrition guidelines, eliminating unhealthy foods from the school setting, and establishing mechanisms to safeguard public health from conflicts of interest.[10]

The role of families in weight-related issues is just as significant as that of schools. Parents should

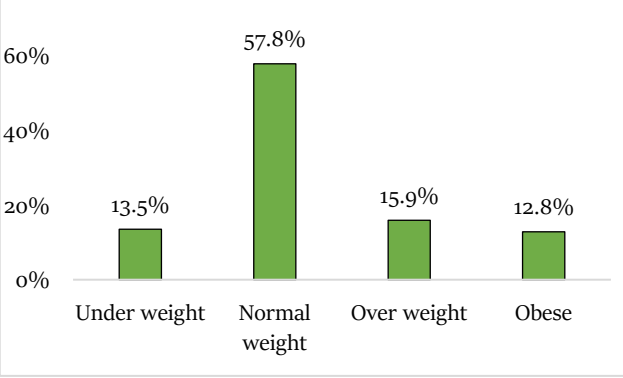

Figure (1): prevalence of overweight and obesity among school students in Saudi Arabia (N= 1133).

encourage a healthy lifestyle at home. This will have a huge effect on the kids' decision on choosing their food at school and fast-food restaurants and on choosing to be physically active.[11]

Between 1998 and 2010, a systematic review included 88.265 children and adolescents (6-19 years old) from Saudi Arabia revealed that the mean prevalence of overweight and obesity was 26.7% (range: 16-42.3%).[12] Other recent studies in Saudi Arabia showed that overweight and obesity among 3613 school-aged children was 14.4% and 7.1% respectively, [13] and overweight was 11.0% and obesity was 7.6% from a national school survey conducted 2018.[14]

To control obesity among schoolchildren in Saudi Arabia, we should investigate underlying factors associated with this problem. these modifiable risk factors can control overweight and obesity. Therefore, the study aimed to assess the relationship between students' lifestyle and obesity through assessing the prevalence of obesity among adolescent schoolchildren in Saudi Arabia and investigating the association between obesity and lifestyle.

METHOD

A school-based survey was carried out among adolescent school students aged 10-18 years old all-over Saudi Arabia during November 2019 and February 2020.

Students attending any type of schools (governmental and private national), from any nationality (Saudi and non-Saudi) in all levels of education (elementary-aged >10 years old - to be sure they can read and comprehend the questionnaire, intermediate and secondary) and both boys and girls were included in the study. Students with endocrine diseases that may cause obesity (Cushing disease, hypothyroidism …etc.), those on cortisone therapy for a long time more than one month, and students attending the evening, international schools, or those with special needs were excluded.

The sample size was estimated to be 1,396 students, depending on the following parameters; the total number of school-children in Saudi Arabia are 4,397,349 [15] and the prevalence of obesity and overweight among students is hypothesized to be 34.3%, [16] with 95% confidence level, power of study 80% and margin of error of 2.5% using Roasoft sample size calculator [http://www.raosoft.com/samplesize.html]. The sample was selected based on a multistage,

Table 1: Socio-demographic characteristics of participants' students.

Sociodemographic characteristics	Total		Normal Weight		Overweight and Obesity		P value
	N= 980	%	N=655	%	N=325	%	
Age (years):							
- Mean ± SD	14.18±2.3		14.28±2.3		14.02±2.3		0.09
Gender:							
- Males	446	44.5	282	63.2	164	36.8	**0.028***
- Females	534	54.5	373	69.9	161	30.1	
Educational Level:							
- Primary	284	29.0	190	66.9	94	33.1	
- Intermediate	329	33.6	205	62.3	124	37.7	0.058
- Secondary	367	37.4	260	70.8	107	29.1	
School type:							
- Governmental	807	82.3	550	68.2	257	31.8	0.059
- Private	173	17.7	105	16.1	68	20.9	
Nationality							
- Saudi	903	92.1	596	66.0	307	34.0	0.57
- Non Saudi	77	7.9	59	76.6	18	23.4	
Fathers' education							
- Illiterate/primary	94	9.6	69	73.4	25	26.6	
- Intermediate/secondary	356	36.3	231	64.9	125	35.1	0.29
- University/postgraduate	530	54.1	355	67.0	175	33.0	
Mothers' education							
- Illiterate/primary	178	18.2	118	66.3	60	33.7	
- Intermediate/secondary	361	36.8	234	64.8	127	35.2	0.45
- University/postgraduate	441	45.0	303	68.7	138	31.3	
Fathers' occupation							
- Not working	69	7.0	52	75.4	17	24.6	
- Working	723	73.8	489	67.6	234	32.4	0.057
- Pension	188	19.2	114	60.6	74	39.4	
Mothers' occupation							
- Housewife	636	64.9	414	65.1	222	34.9	
- Working	303	30.9	212	70.0	91	30.0	0.29
- Pension	41	4.2	29	70.7	12	29.3	
Mothers working hours							
Mean ± SD	6.9±1.2		6.9±1.3		6.8±1.1		0.64
Numbers of family members							
- ≤ 5	274	28.0	194	70.8	80	29.2	0.1
- > 5	706	72.0	461	65.3	245	34.7	
History of obesity in younger age							
- Yes	86	9.0	32	37.2	54	62.8	**<0.001***
- No/don't know	867	91.0	603	69.5	264	30.5	
Family history of obesity							
- Yes	285	29.9	143	50.2	142	49.8	**<0.001***
- No/don't know	667	70.1	491	73.6	176	26.4	

** Significant at p<0.05*

Table (2): Some dietary habits of the studied students relative to their weight.

Dietary habits	Normal Weight		Overweight and Obesity		*P* value
	N=655	%	N=325	%	
Numbers of main meals taken daily					
- < 3 /day	251	66.6	126	33.4	0.89
- > 3 /day	404	67.0	199	33.0	
Breakfast frequency:					
- ≥ 5 days /week (daily)	375	68.2	175	31.8	
- 3 – 4 days /week	127	65.5	67	34.5	0.59
- < 3 days /week	153	64.8	83	35.2	
Place of having breakfast:	N=620		N=315		
- At home	320	66.3	163	33.7	0.97
- At school	300	66.4	152	33.6	
Eating during TV watching	**N=654**				
- Yes	224	63.5	129	36.5	
- Sometimes	272	73.1	100	26.9	**0.004***
- No	158	62.2	96	37.8	
Eating during psychological stress					
- Yes	119	68.4	55	31.6	
- Sometimes	128	68.8	58	31.2	0.66
- No	408	65.8	212	34.2	
Eating meals at specified times					
- Yes	413	67.7	197	32.3	0.44
- No	241	65.3	128	34.7	
Whole family eating meals together					
- Yes	545	65.4	288	34.6	**0.019***
- No	110	75.3	37	24.7	
Fast food consumption					
- ≥ 5 days /week	28	56.0	22	44.0	
- 3 – 4 days /week	116	75.8	37	24.2	**0.013***
- < 3 days /week	511	65.7	266	34.3	
Place of taking fast foods $					
- School	135	71.4	54	28.6	0.14
- Home	564	68.3	262	31.7	**0.026***
- Others (outside/club)	124	62.9	73	37.1	0.19
With whom you eat fast foods $					
- Alone	113	65.3	60	34.7	0.64
- Friends	148	74.7	50	25.3	**0.008***
- Family	566	67.3	275	32.7	0.45

** Significant at p<0.05, $ total more than 100% due to multiple choices.*

stratified, simple random procedure. Through stratification, a good representation of both genders and different levels of education. A proportional weighted sample according to the region was selected.

Data collection tool: Semi-structured questionnaire, modified Arab Teens Lifestyle (ATLS) Questionnaire) [17] was used to assess students' lifestyles and other risk factors of obesity. It includes the following items: (1) *General information*: Region, type of school, educational level, and nationality. (2) *Socio-demographic characteristics*: age, gender, residence, parents' education, and occupation, and family size, and mothers' work hours. (3) *Awareness of healthy dietary habits:* awareness about health plate and source of their

Table (3): Dietary behaviors of the studied students regarding their weight classification.

Dietary behaviors	Normal Weight		Overweight and Obesity		*P* value
	N=655	%	N=325	%	
Fruits consumption:					
- ≥ 2 serving /day	142	73.6	51	26.4	**0.026***
- < 2 serving day	513	65.2	274	34.8	
- ≥ 5 days /week	237	68.7	108	31.3	
- 3 – 4 days /week	170	66.7	85	33.3	0.62
- < 3 days /week	248	65.3	132	34.7	
Vegetable's consumption:					
- ≥ 2 serving /day	155	72.8	58	27.2	**0.038***
- < 2 serving day	500	65.2	267	34.8	
- ≥ 5 days /week	321	65.9	166	34.1	
- 3 – 4 days /week	138	70.0	59	30.0	0.56
- < 3 days /week	196	66.2	100	33.8	
Milk products consumption:					
- ≥ 2 serving /day	205	73.5	74	26.5	**0.005***
- < 2 serving day	450	64.2	251	35.8	
- ≥ 5 days /week	358	65.0	193	35.0	
- 3 – 4 days /week	116	67.4	56	32.6	0.3
- < 3 days /week	181	70.4	76	29.6	
French fries consumption					
- ≥ once /day	533	66.1	273	33.9	0.31
- < once /day	122	70.1	52	29.9	
- ≥ 5 days /week	156	58.6	110	41.4	
- 3 – 4 days /week	188	71.5	75	28.5	**0.003***
- < 3 days /week	311	69.0	140	31.0	
Chocolate and sweets consumption					
- ≥ 5 days /week	205	65.7	107	34.3	
- 3 – 4 days /week	172	66.9	85	33.1	0.86
- < 3 days /week	278	67.6	133	32.4	
Carbonated/ sugar sweetened drinks	463	63.8	263	36.2	**0.001***
- ≥ once /day	192	75.6	62	24.4	
- < once /day	217	61.5	136	38.5	
- ≥ 5 days /week	104	60.8	67	39.2	**<0.001***
- 3 – 4 days /week	334	73.2	122	26.8	
Energy drinks consumption					
- ≥ once /day	165	67.1	81	32.9	0.93
- < once /day	490	66.8	244	33.2	
- ≥ 5 days /week	36	63.2	21	36.8	
- 3 – 4 days /week	39	72.2	15	27.8	0.59
- < 3 days /week	580	66.7	289	33.3	
Fast food consumption daily					
- ≥ once /day	432	64.5	238	35.5	**0.02***
- < once /day	223	71.9	87	28.1	

* Significant at p<0.05.

information and food label awareness. (4) *Dietary habits:* number of the main meals, frequency of eating breakfast, frequency of eating healthy foods (fruits, vegetables, milk), frequency of eating unhealthy foods (fast food, chocolate, carbonated/sweets drinks, energy drink), eating while watching television, eating during

Table (4): Physical activity and sedentary lifestyle behavior among school students

Variables	Normal Weight		Overweight and Obesity		*P* value
	N=655	%	N=325	%	
Computer/internet games during weekdays:					0.88
- ≥ 3 hours/day	346	67.1	170	32.9	
- < 3 hours/day	309	66.6	155	33.4	
Computer/internet games during weekend:					0.064
- ≥ 3 hours/day	461	65.1	247	34.9	
- < 3 hours/day	194	71.3	78	28.7	
watching TV during weekdays:					0.79
- ≥ 3 hours/day	168	66.1	86	33.9	
- < 3 hours/day	487	67.1	239	32.9	
watching TV during weekend:					0.87
- ≥ 3 hours/day	327	66.6	164	33.4	
- < 3 hours/day	328	67.1	161	32.9	
Physical activity ≥ 60 minutes daily					0.11
- ≥ 5 days /week	133	64.6	73	35.4	
- 3 – 5 days /week	259	64.3	144	35.7	
- < 3 days /week	263	70.9	108	29.1	
Sleeping hours daily					0.8
- < 8 hours	292	67.3	142	32.7	
- ≥ 8 hours	363	66.5	183	33.5	

psychological stress; and sharing foods with the whole family. (5) *Physical activity:* frequency of physical activity practice, hours watching television, video games, browsing internet and daily sleeping hours. (6) *Family and medical history* of chronic diseases and obesity at young age.

Data collection methods: The data was collected by trained coordinators from school health department in each health directorate all over 22 health regions in Saudi Arabia after coordination with education departments and school managers. They selected the school randomly proportional to each region. The students completed the questionnaire in paper form then the health coordinators entered it regionally through google form.

Pilot study: A pilot study was conducted on 25 students to test the logistics of data collection, clarity of data collection tools, and to estimate the timing for data collection. There was modification in some question language and name of food to match with Saudi culture and delete question of frequency of eating fata and oil daily and weekly. So, data from the pilot study were not included in the study.

Anthropometric measurements: Weight and height were self-reported by the participants and recorded. Body Mass Index (BMI) was calculated using the equation: BMI= weight [kg]/height [m] ^{2} and plotted on the BMI growth charts for Saudi children and adolescents. [18] Participants were classified into underweight: <5th percentiles, healthy weight: 5th-85th percentiles, overweight: 85th-95th percentiles, and obese: >95th percentiles. [19]

Data management: The data was extracted centrally as an excel sheet, coded, and analyzed through SPSS software version 25 [SPSS Inc., Chicago, IL, USA]. Frequency distribution and cross-tabulation were used to check for data entry errors. Data were tested for variance homogeneity by the Shapiro-Wilk test.

Quantitative data were represented by mean and standard deviation [SD] for normally distributed data. Qualitative data were represented by frequency and percentage. Student's t-test and chi-square test were used as appropriate. Multiple logistic regression was

conducted to predict the most important risk and protective factors influencing students' weight with odds ratio (OR) and 95% confidence interval (CI). The results were considered significant at a p-value of <0.05 on both sides.

RESULTS

A total number of 1,396 students were recruited for the study; 263 of them were excluded due to missed and incomplete data with a response rate of 81.2% (1133). The study revealed that 153 (13.5%) of students were underweight who were excluded from analysis as they may have specific lifestyles and behaviors that can disturb results if added to normal ones (as non-obese). More than half of the studied students were of normal weight (57.8%). However, the prevalence of overweight and obesity was (15.9% and 12.8%) respectively (Figure 1).

The mean age of studied students was 14.18±2.33 years; 54.5% were females; 82.3% were from governmental schools, and 92.1% had Saudi nationality. Their education level distribution was (29%, 33.6%, and 37.4%) at primary, intermediate, and secondary levels, respectively. Regarding socio-demographic characteristics of the family, about half of students' fathers and mothers were university/postgraduate education (54.1% and 45%) respectively. Most of students' fathers were working (73.8%) and had more than five family members (72%).

Male gender, positive family history of obesity, and history of obesity at younger age were significantly associated with overweight and obesity among studied students (p<0.05). However, there were no statistically significant differences between both studied groups regarding other sociodemographic factors (Table 1).

Table 2 shows some dietary practices of the studied students relative to their weight. In which sharing eating with the whole family, and fast-food consumption ≥ 5 times weekly were significantly higher among students having overweight and obesity compared to normal ones respectively. While watching TV while eating, having fast food at home, and sharing it with friends was significantly higher among normal-weight students.

Regarding dietary behavior of the studied students; it was found that French-fried, carbonated/sugary sweetened drinks consumption ≥ 5 days weekly, fast food consumption, and carbonated/sugary sweetened drinks daily were significantly higher among students having overweight and obesity compared to those consume < 3 days weekly. Meanwhile, fruits, vegetables, and milk products consumption ≥ 2 servings daily were significantly lower among overweight and obese students (26.4%, 27.2%, and 26.5%) compared to normal-weight ones (73.6%, 72.8%, and 73.5%) respectively (Table 3).

Table 4 shows that more than two-thirds of students in normal weight and one third in overweight/obese groups using computer/internet games ≥ 3 hours daily during weekdays and during weekend (67.1% vs 32.9% and 70.4% vs 34.9%) respectively. Watching TV during weekdays and weekends was (66.1% vs 33.9 and 66.6% vs 33.9%) among normal and overweight/obese students respectively. Two thirds of normal students practice physical activity less than 3 days weekly (67.1%) compared to overweight and obese ones (32.9%) and about two-thirds of them sleep ≥ 8 hours daily (66.5% vs 33.5%) respectively with no statistically significant differences between both groups regarding physical activity, and sedentary lifestyle behavior.

Multiple logistic regression analysis showed that the main predictor factors that were significantly associated with overweight and obesity were: positive history of obesity at younger age (OR: 3.11; 95% CI 1.89 - 5.501), positive family history of obesity (OR: 2.62; 95% CI 1.92 - 3.58), Consuming French fries ≥ 3 days /week (OR: 1.6; 95% CI 1.18 - 2.19) and consuming milk products less than twice daily (OR: 1.5; 95% CI 1.06 - 2.14). However, surprisingly, family not gathering during eating food (OR: 0.5; 95% CI 0.32 - 0.77), consuming fast food ≥ 3 days /week (OR: 0.53; 95% CI 0.36 - 0.78) or eating fast food at home (OR: 0.67; 95% CI 0.45 - 0.99) were associated with lower prevalence of overweight and obesity (Table 5).

DISCUSSION

The current study was conducted to assess the prevalence, and lifestyle factors associated with obesity among adolescent school students in Saudi Arabia.

The prevalence of total overweight and obesity among studied adolescents was 28.7%. A slight reduction was observed when compared to previously published prevalence by

Table (5): Multinomial Logistic regression between selected lifestyle factors and overweight/obesity in schoolchildren in Saudi Arabia.

Predictor factors	Overweight and obesity [a]			
	B	S. E	*P* value	OR (95% CI)
Intercept	-3.594	0.616	**<0.0001**	
Gender: Female [b] - Male	- 0.217	- 0.152	1.00 0.154	1.24 (0.92 – 1.67)
History of obesity in younger age: No [b] - YES	- 1.13	- 0.252	1.00 **<0.001***	**3.09 (1.89-5.06)**
Family history of obesity: No b - YES	- 0.959	- 0.160	1.00 **<0.001***	**2.61 (1.91-3.57)**
Eating during TV watching No [b] - YES	- 0.189	- 0.158	1.00 0.23	1.21 (0.89-1.65)
Whole family eating meals together: YES [b] - No	- -0.703	- 0.226	1.00 **0.002**	- **0.5 (0.32-0.77)**
Fast food frequency/week: < 3 days /week [b] - ≥ 3 days /week	- - 0.641	- 0.199	1.00 **0.001***	**0.53 (0.36-0.78)**
Fries consumption weekly: < 3 days /week [b] - ≥ 3 days /week	- 0.459	- 0.162	1.00 **0.005***	**1.58 (1.15-2.18)**
Carbonated/ sugar sweetened drinks weekly: < 3 days /week [b] - ≥ 3 days /week	- 0.066	- 0.173	1.00 0.70	1.07 (0.76-1.50)
Sharing fast food with friends: No[b] - Yes	- - 0.382	- 0.195	1.00 0.05	0.68 (0.47-1.0)
Eating fast food in the home: No [b] - Yes	- - 0.400	- 0.200	1.00 **0.045***	**0.67 (0.45-0.99)**
Fast food daily: < 1 once [b] - ≥ 1 daily	- 0.29	- 0.183	1.00 0.11	1.34 (0.93-1.91)
Carbonated /sugar sweetened drinks daily: < 1 once [b] - ≥ 1 daily	- 0.268	- 0.210	1.00 0.20	1.31 (0.87-1.97)
Milk products consumption daily: ≥ 2 serving [b] - < 2 serving	- 0.405	- 0.179	1.00 **0.024**	**1.5 (1.06-2.13)**
Fruits consumption daily: ≥ 2 serving [b] - < 2 serving	- 0.407	- 0.209	1.00 0.05	1.5 (0.99-2.26)
Vegetables consumption daily: ≥ 2 serving [b] - < 2 serving	- 0.122	- 0.203	1.00 0.55	1.13 (0.76-1.68)

[a] *normal weight was used as the reference category,* [b] *Reference category, * Significant at p<0.05. OR = odds ratio, CI = confidence interval.*

AlBuhairan et al. 2015 (30%) and Al-Hussaini et al. 2015 (34.7%).[20, 21] Conversely, our figure is higher than that reported by the national school-based BMI survey conducted in 2018 (24.3%).[14] These differences could be attributed to the tool used in assessing the category of students' BMI, as the first two studies used Centers for Disease Control (CDC) and WHO growth charts, respectively, and an overestimation of the prevalence might occur. Additionally, different socio-demographic background variables of the studied students could be a reason for different prevalence as Al-Hussaini et al. 2015,[21] studied population was only

students in Riyadh city, Saudi Arabia and the current study is a national-wide one. Self-reported weight and height by students may be another reason as well.

The present study revealed that being obese at a younger age increased the chance of being obese in adolescents by more than three times, which is supported by previous studies in Al-Ahsa, Saudi Arabia and South-West of England.[22, 23] It is well known that childhood obesity is associated with a greater chance of obesity, premature death, and disability in adulthood. Besides increased future risks of being obese, obese children are at risk of many health problems such as breathing problems, increased risk of fractures, hypertension, insulin resistance, and psychological effects. [2] This indicates the importance of emphasizing the concept of making physical activity as part of a child's life at an early age, as the CDC recommends that the children should be encouraged to be physically active for 60 minutes or more each day, with activities ranging from informal, active play to organized sports.[24]

Male adolescents were at more risk of being overweight/obese when compared to females using bivariate analysis. However, when underwent multivariate analysis, the association was insignificant. Other studies have revealed a positive association between being male and obesity among adolescents in Saudi Arabia.[20,21] However, multivariate analysis was not performed in these articles. On the other hand, Al-Hazzaa et al. 2012 reported a positive association between being male and overweight/obesity among Saudi adolescents in both bivariate and multivariate analysis. [25] The variance between genders about overweight/obesity could be attributed to that female adolescents are more concerned about their body image and more likely to control their weight.[26]

An additional significant factor associated with the obesity among the studied group is having a family history of obesity, as having one or more obese family members increased the risk of obesity among the adolescents by two and half folds when compared to those that have no family members with obesity. This was consistent with Nurul et al. who found that father's obesity was associated with a 5-fold increase in obesity risk among Malays' Adolescents.[27] Moreover, the previously mentioned study in Al-Ahsa, Saudi Arabia reported a significant association between the obesity of male adolescents and their parents' obesity.[22] This relationship is suggested to be due to genetic variations in those adolescents that make them more prone to high food intake, physical inactivity, a decrease in metabolism, and a higher tendency to store body fat.[28, 29] Furthermore, studies have shown that the Gene-Environment interaction results in an interplay between genetic and environmental factors such as sharing the same unhealthy dietary habits and physical inactivity in the whole family.[30]

Regarding family eating habits; gathering family during meal eating was positively associated with increased risk for overweight/obesity in adolescents, compared to those who are not eating with their families. The association between overweight/obesity among adolescents and eating meals with family is controversial. Alamri, 2020 found that there was a significant positive relationship between eating lunch and dinner with family and the BMI of female adolescents, but no association was found between having breakfast with the family and the BMI when conducted cross sectional study in Tabuk, Saudi Arabia. [31] Similarly, Sedibe et al. 2018 as well revealed that eating the main meal with family some days and almost every day was associated with a higher risk of being overweight and obese among black South African adolescents. [32] On the other hand, Saleh et al. 2017, Haghighatdoost et al. 2017, and Frank et al. 2019 found that adolescents who gathered with their families during eating the meal were significantly at lower risk of having overweight/obesity when studied among Saudi, Iranian, and German adolescents. [22, 33,34] Moreover, Fulkerson et al. 2009, reported that adolescents who had no family dinners were nearly three times more likely to be overweight than adolescents who ate five to seven family dinners per week when conducted a study in Minneapolis/St. Paul metropolitan, United States of America. [35] However, Babajafari et al., 2011, Utter et al. 2013, and Chen et al., 2019 revealed that there was no statistical association between family food frequency and BMI when studied among Australian, New Zealanders, and American adolescents**.** [36-38] The inverse association could be attributed to that parent usually determine the type of eaten meal which may be lacking in nutritious, processed, and energy-dense meals due to several socioeconomic factors. Moreover, eating habits, such as serving large portions of meals to children and enforcing or encouraging them to finish

it may contribute to increasing the weight of the children. [39, 40]

In the context of fast food consumption and the risk of overweight/obesity, the current study revealed significant inverse associations between overweight/obesity among adolescents and increased frequency of consuming fast food and eating this food at home**.** [41] Similarly, an international cross-sectional study that included Eastern Mediterranean countries such as Oman and Jordan revealed that lower BMI was significantly associated with greater weekly fast food consumption among adolescents. [42] Additionally, an Australian longitudinal study on women's health for 16 years found that BMI was significantly lower among occasional and frequent consumers of takeaway food compared to never or rarely takeaway consumers.[43] Conversely, it is documented that more consumption of fast food increases the risk of overweight/obesity among Saudi and Caribbeaners adolescents.[25,44] Furthermore, no significant association was found between using fast food deliveries/takeaway and BMI among adults in the United Kingdom. [41] Lastly, fast food consumption more than five times in the week is inversely related to overweight/obesity among Qatari adolescents as well.[45] One justification for this result is that an adolescent might share the fast food with family members and not finish it alone, which may not result in increasing calories intake that results in weight gain.

The current study revealed that weekly consumption of fries and daily consumption of fewer milk products increased the risk of obesity/overweight by about one and a half folds. Consistent with the current study, a systematic review of ninety-four observational and intervention studies revealed an inverse association of high consumption of milk and other dairy products with body fatness in children and adolescents.[46] Concerning fried food association with overweight/obesity, a systematic review supported the result of the current study as it found that a diet with a lower percentage of obesogenic foods that include fried food was effective in reducing the risk of developing obesity among children and adolescents.[47] However, some dietary behaviors were significantly associated with overweight/obesity in the bivariate analysis, but when entered the multiple regression model were not significant such as daily and weekly carbonated sugar-sweetened drinks, daily fast food, daily fruit, and daily vegetable consumption. However, the fundamental reason for overweight/obesity is an energy imbalance between calories intake and calories expended not due to specific types of food. [2]

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, overweight and obesity among adolescents in Saudi Arabia is still a problem that needs a solution strategy. The main reason for overweight and obesity is an energy imbalance between calories intake and calories expended not due to specific types of food in the school age. Some factors may increase the risk of being overweight or obese among adolescents, such as having a history of obesity at a younger age, family history of obesity, being in a family that gathers to eat the meals, more consumption of fries and less milk consumption. Fast food eating frequency and eating fast food at home decreased the risk of overweight and obesity among adolescents. Although there was no significant difference between adolescents' weight and physical activity practicing in this study, this is not preventing us to recommend engaging children in physical activity from an early age, which is an essential pillar to prevent overweight and obesity later in adolescence. Obesogenic food limitations at home should be considered to prevent risky consequences. Adopting healthy lifestyle and dietary behaviors should start as early as possible from infancy and preschool age and struggling to change unhealthy lifestyle at all levels through adopting health in all policies.

Limitations of the study: The main limitations of the current study are recall bias and self-reporting of weight and height. A cross-sectional study design that cannot establish causal association. Besides, lack of the nature and details of consumed foods, and lack of details about types and duration of physical activity. Further prospective studies about effect of lifestyle and dietary behavior modifications on adolescents' obesity and improving parents' awareness and knowledge about lifestyle modification and its effects on their children health.

Ethical considerations

The central institutional review board of the Ministry of Health approved the study, registration number (20-193M). All participants received informed consent from parents and assent for students before participating in the

study indicating the purpose of the study. Participants' confidentiality and anonymity were assured.

Conflicts of interest: The authors have no conflicts of interest to declare.

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