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Relationship between food habits and body weight of Saudi adolescent females, cross-sectional study.

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Abstract

The poor dietary habits have remarkably increased among Saudi female adolescents. This study purposed to identify adolescent females according to their food habits and explore impact of food habits on their body weight. Two hundred and twelve adolescent girls (age15-17 years) were chosen randomly from secondary schools in Dammam, Eastern Province, Saudi Arabia. A list of 12 food habits (total 12 marks), including daily meals, eating breakfast, skipping meals, snacks, eating fatty foods, fats used in cooking, method of cooking, fast foods, carbonated beverages, coffee, and vegetables, were used. According to the food habits score, the females were classified into 3 groups: poor (<6 marks), acceptable (6 < 9 marks), and good (>=9 marks). The 24-hour dietary recall for 3 days was also done, and nutrient intake was calculated. Also, body weight, height, and BMI were determined. The results revealed that 61.8% of subjects had a healthy weight, 21.7% were overweight, and 16.5% had obesity. Only 3.8% of the studied adolescents had good food habits (score >= 9), and more than half of the subjects had poor food habits. Pearson correlation coefficient revealed that only fast foods consumption and drinking carbonated beverages (r=0.17 and 0.14 at P<0.05 respectively) has a positive and significant correlation with body weight. It was evident from the results that remarked deficiency was observed in the intake of fiber, thiamin, niacin, vitamin A, and calcium. In conclusion, adolescent females had poor food habits, and most of the subjects with poor food habits suffered from overweight or obesity.

Keywords: Obesity, Carbonated Beverage, Fat, Eating Habit, Fast Food, Nutrient

1. Introduction:

INCREASED weight and obesity among young adolescents are alarming in Saudi Arabia [1]. When an individual reaches adulthood, public health problems have adverse effects, both short and long-term, resulting in obesity. The behavioral and environmental factors, including lousy eating habits, decreased physical activity, and

increased energy supply, usually contribute to developing co-morbidities of obesity. Similarly, overweight and obesity are associated with a higher risk of developing chronic diseases such as cardiovascular diseases [2].

The consumption of fast foods, carbonated beverages, and energy drinks has remarkably increased and replaced nutritious meal consumption [3,4]. Moreover, decreases in physical activities are commonly correlated with the development of obesity-related symptoms [3,4]. A sedentary lifestyle is associated with decreased consumption of nutritious foods, which leads to increased BMI and obesity.

The leading risks for cardiovascular disease and mortality are unhealthy food habits and physical inactivity[5]. To maintain appropriate BMI, the World Health Organization has recommended limiting the intake of fats and sugars, increasing physical activity, and increasing consumption of fruits and vegetables in the diet [6].

Previous researches on adolescents revealed that healthy dietary habits and physical activities are interlinked. Adolescents who maintained a high level of physical activity consumed a healthy diet [7]. On the contrary, the lowest prevalence of healthy dietary patterns was reported in adolescents having a sedentary lifestyle[8].

Adverse health outcomes were associated with a sedentary lifestyle and physical inactivity[9]. Studies found an association between healthy food choices and physical activity among adolescents, whereas unhealthy diet and sedentary lifestyle are linked [10].

High fat and sugar diet are linked with medical complications, including hypertension, diabetes, dyslipidemias, and metabolic syndrome [11]. The increase in BMI among females was mainly due to lifestyle changes, increased consumption of energy-dense foods (e.g., saturated fats and refined carbohydrates), and eating outside [12].

It was estimated through a recent analysis that consumption of additional 12 ounces of sugary items in diet per day increases BMI by 0.08 units, thereby causing obesity [13]. Cutting down the consumption of sugary diet has proved to play an essential role in weight loss and maintaining health status among adolescents.

The main objectives of this study were to: (1) find out the prevalence of overweight and obesity among Saudi adolescent females (2) sort adolescent females according to their food habits, and (3) explore the adequacy of nutrients intake with regard to body weight.

2. Subjects and Methods

2.1 Subjects

A cross-sectional study was carried out in Dammam, Eastern Province, Saudi Arabia. The study has randomly selected 212 Saudi adolescent females from secondary schools aged between 15 and 18 years (16.7±0.9 years). The sample was obtained through a multi-stage random sampling procedure; initially, three schools were randomly selected from a list of schools in Dammam. Afterward, a list of classes was created for each targeted grade (from grade one to grade three). All classes from each grade were selected (a total of 27 classes). The average number of students per class was about 25, which meant approximately 675 female students were eligible.

The adolescents, who were not Saudis, lived outside Eastern Province, suffered from disabilities, took medication for chronic diseases, or athletes were excluded from the study. A total of 212 Saudi adolescent females were eligible and enrolled in the study.

2.2 Methods

2.2.1 Demographic and Health Data

The demographic data about the participants has been obtained through a particular form. Similarly, the interviewer has also asked about any chronic disease and medications history. Subjects were also asked about their opinion regarding their body weight, body image, family members suffering from obesity, dietary regimen, and supplements.

2.2.2 Anthropometric Indices

The participant's height was assessed using a stadiometer scale, and body weight was measured through a standardized process. In regards of height and weight, the researchers has also calculated BMI, which was used for classifying subjects into overweight: >+1SD (equivalent to BMI 25 kg/m2), obesity: >+2SD (equivalent to BMI 30 kg/m2), thinness:< -2SD, and severe thinness:<-3SD [14]. BMI classification was based on standards given by CDC [14].Waist circumference (WC) was measured by non-stretchable tape and obtained at a horizontal plane midway between the iliac crest and the lower rib margin to the nearest 0.1 cm. The hip circumference was measured at the point that yielded the maximum circumference over the buttocks.

2.2.3 Food Habits and Nutrients Intakes

As for food habits classification, the researchers applied a list composed of 12 variables related to the most common food habits (box 1). Then the food habits score of the subjects was calculated out of 12 and classified as poor food habits (score less than 6, <50.0%), acceptable food habits (score 6 to 9, 50 to 75%), and good food habits (score equal or more than 9, >75%).

Box 1: Variables for classifying food habits of studied subjects.

Variable	Response	Score
1- Daily meals	*3 meals*	1
	< 3 and > 3 meals	0
2- Eat breakfast regularly	*Yes/ sometimes*	1
	No	0
3- Skipped meal	*None*	1
	Any essential meal	0
4- Eat snacks (unhealthy snacks only e.g. chips, chocolate ...etc.)	*No*	1
	Yes	0
5- Eat fatty foods regularly (e.g. cream, broasted with skin, fatty meats, .etc.)	*Skim/ low/ medium fat*	1
	Whole fat	0
6- Fats used in cooking	*Oils/ Mixture from oil and natural ghee*	1
	Butter/margarine/ghee/hydrogenated	0
7- Method of cooking	*Boiling /Simple/Grilling*	1
	Stewing/Frying/ similar methods	0
8- Eat fast foods	*None*	1
	Regularly/ sometimes	0
9- Preferred fast food	*Pasta with Vegetables/Fish/Cheese*	1

Variable	Response	Score
	Meat/Chicken/Burger/Pizza	0
10- Drink Carbonated beverages and/or energy drinks	*None*	1
	Regularly/ sometimes	0
11- Drink Coffee (small cups)	*Less than 3 times/day*	1
	Regularly (3 times or more/day)	0
12- Eat fresh vegetables	*> = 3 times/week*	1
	< 3 times week	0
Classification of Food Habits	*Poor (less than 6, <50.0%),*	< 6
	Acceptable (6 to 9, 50 to 75%)	6 < 9
	Good (equal or more than 9, >75%)	>= 9

Note: All controversial variables, e.g., drinking tea, were excluded; also, all authors noticed that subjects were eating fruits or drinking fruit juices every day.

For estimating nutrient intakes, the interviewers asked the respondents to recall, describe, and quantify the foods and drinks consumed over the previous 24 hours (for three different days, including holidays). The consumed foods were tabulated and converted into grams then analyzed accordingly with the Saudi and Gulf food composition tables in the Arab Gulf countries [15].

2.2.4 Standard dietary requirements

The intakes were then compared with standard dietary requirements. Daily energy requirements (kcal/kg/day) were calculated for each participant using the formula given by IOM [16]; protein as 1.0 g/kg/day, dietary fat as 25% of total energy requirements, carbohydrates by differences (g/day), and fiber as 26 g/day. The minerals and vitamins requirements were calculated using the adequate intakes (AI) given in DRI standards [16].

2.2.5 Statistical Analysis

All obtained data were statistically analyzed and presented as frequency and percentage or mean ± SD. The significant differences for numerical variables were calculated by ANOVA and followed up by LSD. Categorical variables were compared using the Chi-square test, and a 95% confidence interval was used.

2.2.6 Ethical Consideration

Both of participants and their parents were consented. Essential information about the study, objectives, and procedures, along with researchers 'contact information, was also provided to the participants.

This study was approved by King Abdullah International Medical Research Center (KAIMRC), Ministry of National Guard, Health Affairs, Eastern Province, Kingdom of Saudi Arabia (KSA), and The University of Dammam Institutional Review Board (IRB) Committee (# IRB- UGS- 2015-03- 214).

3. Results

Table 1 showed that the age of the majority of adolescents were 17 years (37.0%) and 16 years (32.2%). 52.8% of the subjects' mothers were housewives, and one-third were employed. On the other hand, most subjects' fathers were employed

(66.0%), and about one-third were retired (31.4%). Education level for most subjects' mothers and fathers was university (41.7% and 41.3% respectively) and secondary (33.7% and 34.7% respectively). The family size for most of the subjects (59.4%) were 6 to 8 persons. The income of the majority (47.6%) were more than 15000 SR/month.

Table 1: General characteristics of studied Saudi adolescent females

	Less than secondary	*Secondary and Diploma*	*University*	*Postgraduate*	*Total*
Education (mother)	34(16.1%)	81(38.2%)	89(42.0%)	8(3.8%)	212(100.0%)
Education (father)	22(10.4%)	83 (39.4%)	88 (41.3%)	19 (9.0%)	212(100.0%)
	Housewife	*Retired*	*Employee*	*Other*	*Total*
Mother job	113(53.3%)	23 (10.6%)	71 (33.5%)	5 (2.6%)	212(100.0%)
Father Job	-	6(2.6%)	66(31.4%)	140(66.0%)	212(100.0%)
Family Size		*Less than 6*	*6 to 8*	*More than 8*	*Total*
	-	43(20.3%)	126(59.4%)	43(20.3%)	212(100.0%)
Family income (SR/month)	*Unknown*	*Less than 5000*	*5000 to 10000*	*10000 to 15000*	*More than 15000*
	15(7.1%)	6(2.8%)	21(9.9%)	69(32.5%)	101(47.6%)

As shown in Table 2, most Saudi adolescent females had normal BMI (61.8%). However, more than one-fourth of females were overweight (21.7%) and (16.5%) were obese. The results in table 2 were used as a base for all mentioned results where the researchers compared among the three groups with studied variables.

As shown in table 3, there was no significant difference in the mean age for all studied groups. As for body weight, BMI, waist circumference, and hip circumference, there were significant differences between the values of obese subjects and the normal group who had the lowest values. There was no significant difference among the studied three groups concerning body height and waist to hip ratio.

As shown in Table 4, most obese subjects (78.6%), half of the overweight subjects, and about one-fifth of normal subjects thought they had obesity. On the other hand, 33.6% of normal, 65.2% of overweight, and 74.3% of obese subjects were not satisfied with their body image. According to table 4, obesity was common among 49.1% of subjects' families, especially overweight and obese subjects' families (58.7% and 51.4%, respectively). Siblings were the most obese or overweight persons in normal, overweight, and obese families (19.5%, 32.6%, and 22.9%, respectively). Only 11.4% of obese and 20.7% of overweight subjects were following dietary regimens for weight loss. All the obese subjects and more than 90% of normal and overweight subjects took dietary supplements.

As shown in Table 5, the majority of all studied subjects (>42.0%) consumed three meals daily, while 20.0% of obese and 18.5% of overweight subjects consumed more than three meals daily. Furthermore, the similarity was observed for consuming breakfast daily, where two-thirds of subjects did have their breakfast regularly. In contrary, breakfast was the most skipped meal among the studied groups with no significant difference. There was a similarity among the studied groups concerning snacks consumption, as 85.7% of obese, 89.3% of normal, and 93.5% of overweight subjects consumed snacks.

Table 2: Classification of studied Saudi adolescent females according to BMI

	Frequency	Percent
Normal (18.5 < 25 kg/m2)	131	61.8%
Overweight (25 < 30 kg/m2)	46	21.7%
Obese (> 30 kg/m2)	35	16.5%
Total	212	100.0%

Table 3: Anthropometric measurements of studied Saudi adolescent females

	Normal (n=131)	Overweight (n=46)	Obese (n=35)	ANOVA	
	Mean ±SD	*Mean ±SD*	*Mean ±SD*	*F*	*Sig.*
Age (yr.)	16.8±0.9	16.5±0.9	16.6±0.9	1.68	0.189
Body weight (kg)	52.0±5.4[a]	64.1±5.6[b]	82.7±10.7[c]	311.58	0.000***
Body height (cm)	157.0±5.3	156.3±5.0	158.1±5.2	1.12	0.328
BMI (kg/m2)	21.1±1.6[a]	26.2±1.4[b]	33.0±3.4[c]	548.89	0.000***
Waist circumference (cm)	71.2±6.0[a]	80.0±7.3[b]	91.8±7.3[c]	147.16	0.000***
Hip circumference (cm)	89.7±6.0[a]	99.6±7.1[b]	113.9±8.2[c]	190.65	0.000***
Waist to Hip ratio	0.8±0.0	0.8±0.1	0.8±0.1	1.13	0.324

*Values subscribed with different letters in the same row showed significant differences between these values as calculated by ANOVA and LSD. ANOVA: Analysis of variance. *P<0.05, **P<0.01, and *** P<0.001*

Table 4: History of body weight and obesity among studied Saudi adolescent females

		Normal	Overweight	Obese	Chi ^{2} Tests	
		no (%)	no (%)	no (%)	Value	Sig
Do you have obesity	*Yes*	26 (19.8%)	23 (50.0%)	27 (78.6%)	44.5	0.000***
	No	105 (80.2%)	23 (50.0%)	8 (21.4%)		
Satisfy with body image	*Yes*	87(66.4%)	16 (34.8%)	9 (25.7%)	26.0	0.000***
	No	44 (33.6%)	30 (65.2%)	26 (74.3%)		
Anyone in family have obesity	*Yes*	59 (45.0%)	27 (58.7%)	18 (51.4%)	2.6	0.268
	No	72 (55.0%)	19 (51.3%)	17 (48.6%)		
Person who suffer from obesity	*None*	72 (55.0%)	19 (41.3%)	17 (48.6%)	4.0	0.410
	Parents	25 (19.1%)	7 (15.2%)	5 (14.3%)		
	Siblings	25 (19.1%)	15 (32.6%)	8 (22.9%)		
	Both	9 (6.8%)	5 (10.9%)	5 (14.3%)		
Follow dietary regimen	*Yes*	2 (1.5%)	10 (21.7%)	4 (11.4%)	28.4	0.000***
	No	129 (98.5%)	36 (78.3%)	31 (88.6%)		
Take dietary supplements	*Yes*	119 (90.82%)	43 (93.5%)	35 (100.0%)	3.2	0.524
	No	12(9.2%)	3 (6.5%)	0(0.0%)		
	Total	131 (100.%)	46 (100.0%)	35 (100.0%)		

**P<0.05, **P<0.01, and *** P<0.001*

Regarding fat contents of consumed foods and method of cooking, more than half of the obese subjects consumed low-fat milk. Whereas the majority of the

overweight group consumed whole fat milk, more than 45.0% and 45.0% of the normal group consumed low/medium and whole fat milk, respectively. Moreover, most overweight and obese subjects consumed low-fat yogurt, while 47.6% of the normal consumed whole-fat yogurt. More than half of the studied groups consumed whole-fat cheese, especially the obese group. About two-thirds of all studied groups consumed low or medium-fat meat. A considerable percentage of obese (42.9%), normal (30.5%), and overweight (28.3%) subjects were not consuming chicken. Among subjects who consumed chicken, most of them consumed it without skin (obese 46.6%, normal 54.3%, and overweight 40.0%). It was noticed that oil consumption was most common among all studied groups. Moreover, grilling (43.9%) was the more common method for cooking than frying (32.5%). The majority of the overweight subjects (32.6%) and obese subjects (40.0%) were not consuming fish, while most common fast foods consumed were chicken (61.1%) and pizza (56.9%). The percentage of obese subjects who consumed carbonated beverages regularly (> 3 times/week) was higher (57.1%) in comparison with normal (48.1%) and overweight groups (43.5%). The consumption of coffee was prevalent among more than one-fourth of the study groups. The majority of obese subjects consumed vegetables >4 times per week (40.0%), while most of the normal (40.0%) and overweight subjects (37.0%) consumed vegetables < 3 times per week. None of the obese adolescents had good food habits. The prevalence of poor food habits was 73.7% in the normal group, 72.8% in the overweight group, and 60.0% in the obese group. The mean values for food habits score were ranged from 6.7±2.7 for the normal group to 7.1±2.4 for the obese group. However, the statistical analysis did not reveal any significant difference among the groups.

Table 5: Distribution of studied Saudi adolescent females according to food habits

		Normal (n=131)	Overweight (n=46)	Obese (n=35)	Chi2 Tests	
		no (%)	no (%)	no (%)	Value	Sig.
1- Daily meals	*< 3 meals*	60 (45.8%)	20 (43.5%)	15 (42.9%)	22.6	0.012*
	3 meals	56 (42.7%)	17 (37.0%)	13 (37.1%)		
	> 3 meals	15 (11.5%)	9 (19.5%)	7 (20.0%)		
2- Eat breakfast regularly	*No*	31 (23.7%)	8 (17.4%)	7 (20.0%)	1.80	0.772
	Sometimes	55 (42.0%)	21 (45.7%)	16 (45.7%)		
	Yes	45 (34.4%)	17 (37.0%)	12 (34.3%)		
3- Skipped meal	*None*	13 (9.9%)	5(10.9%)	4(11.4%)	5.77	0.673
	Breakfast	39 (29.8%)	11 (23.9%)	10 (28.6%)		
	Lunch	15 (11.5%)	5 (10.9%)	4 (11.4%)		
	Supper	52 (39.7%)	20 (43.5%)	11 (31.4%)		
	Breakfast/supper	12 (9.2%)	5 (10.9%)	6 (17.1%)		
4- Eat snacks (unhealthy)	*No*	14 (10.7%)	3(6.5%)	5 (14.3%)	2.65	0.266
	Yes	117 (89.3%)	43 (93.5%)	30 (85.7%)		
5- Fat content of consumed foods	*None/ or Low fat*	38 (29.0%)	20 (43.5%)	10 (28.6%)	14.2	0.050*
	Medium fat	72 (55.0%)	18 (39.1%)	20 (57.1%)		

		Normal (n=131)	Overweight (n=46)	Obese (n=35)	Chi2 Tests	
		no (%)	no (%)	no (%)	Value	Sig.
6- Fats used in cooking	*High fat*	21 (16.0%)	8 (17.4%)	5 (14.3%)	14.36	0.157
	None	4(3.1%)	2(4.3%)	1(2.9%)		
	Butter/ghee	29 (22.1%)	9 (19.6%)	8 (22.9%)		
	Hydrogenated fat	5 (3.8%)	3 (6.5%)	0 (0.0%)		
	Oils	73 (55.7%)	25 (54.3%)	19 (54.3%)		
	Mix	14 (10.7%)	4 (8.7%)	7 (20.0%)		
	Olive oil	6(4.6%)	3(6.5%)	0(0.0%)		
7- Method of cooking	*Stewing*	4(3.1%)	1 (2.2%)	1 (2.9%)	5.55	0.852
	Frying	42 (32.1%)	15 (32.6%)	12 (34.3%)		
	Grilling	55 (42.0%)	23 (50.0%)	15 (42.9%)		
	Boiling	9 (6.8%)	2 (4.4%)	2 (5.7%)		
	Any methods	21 (16.0%)	5 (10.9%)	5 (14.3%)		
8- Eat fast food Regularly	*No*	0(0.0%)	0(0.0%)	2 (2.9%)	20.12	0.000
	Sometimes	61 (46.6%)	25 (54.3%)	10 (28.6%)		* * *
	Yes	70 (53.4%)	21 (45.7%)	24 (68.6%)		
9- Frequency of fast foods	*No or <once/week*	66 (50.4%)	27 (58.7%)	17 (48.6%)	2.25	0.324
	> once/week	65 (49.6%)	19 (41.3%)	18 (51.4%)		
10- Drink Carbonated beverages	*No*	19 (14.5%)	9 (19.6%)	6 (17.1%)	4.93	0.295
	Sometimes	49 (37.4%)	17 (37.0%)	9 (25.7%)		
	Yes	63 (48.1%)	20 (43.5%)	20 (57.1%)		
11- Drink Coffee (>=3 times/day)	*No*	21 (16.0%)	14 (30.4%)	9 (25.7%)	12.71	0.013*
	Sometimes	75 (57.3%)	18 (39.1%)	17 (48.6%)		
	Yes	35 (26.7%)	14 (30.4%)	9 (25.7%)		
12- Vegetables consumption (times/week)	*Rare*	5 (3.8%)	5 (10.9%)	2 (5.7%)	15.24	0.018 *
	Less than 3	53 (40.5%)	17 (37.0%)	10 (28.6%)		
	3-4	33 (25.2%)	15 (32.6%)	9 (25.7%)		
	More than 4	40 (30.5%)	9 (19.6%)	14 (40.0%)		
Classification of Food Habits	*Poor*	73 (55.7%)	25 (54.3%)	16 (45.7%)	8.68	0.070
	Acceptable	51 (38.9%)	20 (43.5%)	19 (54.3%)		
	Good	7 (5.4%)	1 (2.2%)	0 (0.0%)		
	Total	131 (100%)	46 (100%)	35 (100%)		
		Mean±SD	*Mean±SD*	*Mean±SD*	*Value*	*Sig.*
Food habits score (total 12)		4.98±1.91 [a]	4.83±1.53 [a]	5.11±1.59 [a]	0.537	0.585

*Values subscribed with different letters in the same row showed significant differences between these values as calculated by ANOVA and LSD .. *P<0.05, * *P<0.01, and * * * P<0.001*

The results presented in Table (6) showed that there was a significant and positive correlation between body weight and both eating fast foods and drinking carbonated beverages (r=0.167 and 0.139 respectively at P<0.05). The other body indices did not correlate with food habits.

Table 6: Pearson correlation between body weight indices and food habits

	Body weight	BMI	WC	HC	W/Hip ratio
1- Daily meals	-0.072	-0.091	-0.097	-0.068	-0.074
2- Eat breakfast	0.064	0.055	0.059	0.027	0.064
3- Skip meal	0.029	-0.004	0.020	-0.027	0.100
4- Eat snacks	-0.004	0.064	0.071	0.055	0.031
5- Fat content	0.010	-0.008	-0.005	-0.029	0.041
6- Fats used in cooking	0.006	0.055	-0.033	-0.029	-0.015
7- Method of cooking	0.066	0.071	-0.007	-0.034	0.037
8- Eat fast food	0.167*	0.124	0.098	0.128	-0.022
9- Frequency of fast foods	-0.013	0.003	-0.038	-0.042	-0.011
10- Drink Carbonated beverages	0.139*	0.123	0.094	0.115	-0.007
11- Drink Coffee	0.096	0.096	0.059	0.072	-0.011
12- Vegetables consumption	-0.011	0.014	0.001	-0.010	0.018
13- Food Habits Score	0.070	0.084	-0.057	-0.044	-0.023

*WC: Waist circumference, and HC: Hip circumference. * Correlation is significant at the 0.05 level (2-tailed).*

As shown in Table 7, the obese subjects failed to get their requirements from the mentioned nutrients, except for riboflavin and total iron. Meanwhile, the overweight subjects get their requirements from riboflavin only. The normal group failed to obtain their requirements from nutrients, except for protein, riboflavin, and total iron. The consumption of fiber, thiamin, niacin, vitamin A, and calcium was deficient. In contrast, deficiency of other nutrients was notable among obese and overweight groups.

Table 7: Nutrients intakes by Saudi adolescent females

	Normal (n=131)	Overweight (n=46)	Obese (n=35)	ANOVA	
	Mean±SD (%Std)	Mean±SD (%Std)	Mean±SD (%Std)	F	Sig.
Energy (Kcal)	1217.2±360.8 (65.1%) [a]	1191.5±212.7 (59.4%) [a]	1498.1±232.4 (66.6%) [b]	7.88	0.001* *
Carbohydrate (g)	142.5±28.1 (48.1%) [a]	137.5±25.6 (44.3%) [a]	182.0±29.4 (54.3%) [b]	9.78	0.000* *
Fiber (g)	5.2±1.8 (20.1%)	5.3±1.8 (20.6%)	5.6±1.4 (21.4%)	0.20	0.819
Animal fat (g)	27.1±7.0 [a]	26.6±6.5 [a]	33.1±6.3 [b]	2.85	0.060
Total Fat (g)	46.2±9.0 (89.1%) [a]	44.7±9.7 (80.2%) [a]	52.8±10.7 (84.4%) [b]	2.13	0.122
Animal protein (g)	43.2±11.6 [a]	45.8±13.3 [a]	56.0±12.8 [b]	3.76	0.025*
Total protein (g)	57.9±12.2 (107.1%) [a]	59.7±14.1 (90.5%) [a]	73.8±13.6 (86.2%) [b]	5.30	0.006* *
Vitamin C (mg)	33.1±20.8 (50.9%)	35.7±21.4 (55.0%)	29.8±19.1 (45.8%)	0.21	0.809
Niacin (mg)	3.3±1.4 (23.8%)	2.9±1.9 (20.9%)	3.3±1.2 (23.5%)	0.25	0.782
Riboflavin (mg)	1.3±0.5	1.4±0.5	1.6±0.5	1.75	0.176

	Normal (n=131)	Overweight (n=46)	Obese (n=35)	ANOVA	
	Mean±SD (%Std)	Mean±SD (%Std)	Mean±SD (%Std)	F	Sig.
	(125.8%)	(140.2%)	(160.3%)		
Thiamin (mg)	0.4±0.1	0.4±0.1	0.4±0.1	0.49	0.613
	(38.2%)	(42.4%)	(38.9%)		
Vitamin A (mcg)	199.9±65.2	212.3±63.7	201.7±56.0	0.16	0.849
	(28.6%)	(30.3%)	(28.8%)		
Animal iron (mg)	2.0±0.7	2.2±0.9	2.5±0.8	1.31	0.271
Total iron (mg)	14.9±4.7	13.6±4.2	15.8±4.7	0.73	0.481
	(99.2%)	(90.4%)	(105.5%)		
Phosphorus (mg)	807.1±166.9	799.5±186.8	932.6±190.6	1.95	0.145
	(64.6%)	(64.0%)	(74.6%)		
Calcium (mg)	416.2±107.4	399.9±112.0	520.9±140.2	3.40	0.035*
	(32.0%) [a]	(30.8%) [a]	(40.1%) [b]		

SD: Standard deviation, %Std: Percentage from standard requirements. ANOVA: Analysis of variance
*Values subscribed with different letters in the same row showed significant differences between these values as calculated by ANOVA and LSD. *P<0.05, **P<0.01, and *** P<0.001*

4. Discussion

The results indicated that regardless of subjects' knowledge about healthy eating habits and the educational level of their parents, the eating habits, physical activity, and BMI differed among the adolescent females. This cross-sectional study revealed that intake of fast foods and carbonated beverages leads to an increase in weight among Saudi female adolescents. These findings agreed with articles published recently in KSA and the gulf area [17,18,19]. It is advised that to achieve a healthy BMI; the female adolescent should consume breakfast regularly, increase water intake, and decrease consumption of sugary foods [18,20].

This study revealed that 77.1% of the adolescents were obese, 64.2% overweight, and 47.2% of obese adolescents were not satisfied with their body image. Moreover, 19.6% of overweight and 20% of obese subjects consumed more than three meals daily. In contrast, breakfast was the most skipped meal among the normal, overweight, and obese adolescent females. Fast foods and snacks were consumed by 85.7% of obese and 93.5% of overweight subjects. The prevalence of poor food habits was 71.7% in the overweight group and 60% in the obese group. Overweight and obese female adolescents were found to have deficiencies in intakes from fiber, thiamin, niacin, vitamin A and calcium and failed to cover their requirements from nutrients, except for total protein, riboflavin, and iron.

A study on adolescents in Iran indicated that fruits, vegetables, and dairy products were more frequent among physically active adolescents than non-active adolescents [21].

Indeed, a sedentary lifestyle hurts the eating habits of adolescents, independent of physical activity [22,23,24]. Moreover, consumption of fast food, sweetened beverages/energy drinks, and a lower intake of a healthy diet (fruits and vegetables) led to obesity among French adolescent females [10]. In agreement with our findings, the intake of sweets, fast food, and skipping breakfast was positively associated with a sedentary lifestyle among US female adolescents [25].

The authors believe that active parental mediation is critical in preventing fast food consumption. The media play a crucial role in influencing fast food

consumption; hence, literacy education is essential to alleviate the adverse effects of exposure to junk food marketing [26].

A study conducted among students from Oruro Preto revealed that adolescents' overweight was directly associated with a low-quality diet and decreased physical activity [2]. In the long run, obesity in adolescents may cause many health problems like a high risk of mortality by cardiovascular disease in their adult age. The increase in adiposity (excess weight gain) among adolescents depends on the amount of food intake regarding the composition and the quality of their diet. A nutritious diet including vegetables and fruits is increasingly scarce in the diet of most adolescents. It is encouraged to increase consumption of these food items in their diet to fight against excess weight [27].

Previous studies proved that the consumption of healthy food, including fruits and vegetables, acts as a protective factor for the development of obesity [28]. Higher frequency of sweetened beverages more than three times a week was reported among 57.4% of female adolescents. On the contrary, inverse relation was depicted between BMI and frequency of low-quality diet consumption and sweetened beverages among the Saudi female [29] and male [30] adolescents.

5. Conclusion

No food habits impacted body weight among Saudi adolescent females except for fast foods, carbonated beverages, and vegetable consumption. Also, the diet of all adolescents in this study was deficient in essential nutrients, especially calories, fiber, vitamin A, and calcium. A variety of factors are associated with poor eating habits among adolescents, and society has failed to promote healthy eating habits among adolescents. Adolescents are advised to moderate the consumption of saturated fats and strictly follow the proper diet and exercise guidelines to maintain health. Adequate national policies should be implemented to promote healthy food habits among adolescents as some food habits significantly impact adolescents' health.

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Author contribution

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