Relationship between lifestyle factors and overweight and obesity among Saudis females' adolescents in Eastern Province.

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Abstract

The purpose of this study was to examine the effect of lifestyle factors on body weight among female adolescents in Saudi Arabia. Methodology: this cross-sectional study was carried out on 598 participants. Validated Arab Teens Lifestyle Study (ATLS) questionnaire was used for measuring lifestyle of participants. Data related to lifestyle factors, e.g., physical activity, metabolic equivalent rate (MET), sedentary behavior; food consumption; and anthropometrics indices (i.e. height, weight, and BMI) were collected. ANOVA and logistic regression analysis were used for testing the correlations between BMI and lifestyle factors. Results showed that 20.6% and 19.4% of females were suffered from overweight and obesity, respectively. A significant differences ($P<0.05$) in anthropometric indices, lifestyle behaviors, and food consumption patterns were observed among females. These factors comprised BMI, weight, food consumption pattern (from French fries/potato chips, vegetables, fruits, and cake/donuts) and total physical activity (MET-min/week). Overweight/obesity was significantly associated with the consumption of cake/donuts (odds ratio [OR] for >5 days/weeks =2.261; 95% confidence interval [CI]=1.361-3.757), French fries/potato chips (OR for 3-4 days/weeks=1.936; 95% CI=.206-3.110) and fruit (OR for 3-4 days/weeks=1.669; 95% CI=1.032-2.697). Conclusion: a significant positive association between BMI categories and factors such as eating French fries/potato chips and cakes/donuts were observed among adolescent females.

Keywords: BMI, Diet, Nutrition, French fries, Potato Chips, Donuts, ATLS

1. Introduction

Adolescence is considered a high-risk stage for changes in body weight, as it is a period of developmental plasticity [Hochberg and Belsky, 2013 and Iyer et al. 2017]. It was estimated that in 2010, 35 million adolescents and children in developing countries were overweight and obese [de Onis et al. 2010]. Globally, the prevalence of overweight and obesity between 1980 and 2013 increased in both developing and developed countries 27.5% for adults and 47.1% for children, for a total of 2.1 billion persons considered overweight or obese (Apovian, 2016). The adverse physical consequences of child and adolescent obesity include an increase in cardiovascular risk factors, such as dyslipidemia, hypertension, hyperinsulinemia and impaired glucose tolerance [Zalbahar, 2017]. Female adolescents are most vulnerable to the risk of obesity or weight gain because of consequent maternity-related obesity and unfavorable pregnancy outcomes. Surplus weight acquired during adolescence frequently persists throughout adulthood and is compounded during the childbearing period [Todd et al. 2015]. Several lifestyle factors related to adolescent overweight and obesity have been well documented. For example, it has been documented

that physical activity (PA) is inversely related to body mass index (BMI). Levels of PA have been shown to decrease during adolescence, making this time a significant life period on which research should be focused [Iyer et al. 2017]. Numerous lifestyle factors, for example, healthy dietary choices, PA, sleep duration, vigorous physical activity (VPA), and moderate to vigorous physical activity (MVPA), are significant correlates of adolescent BMI [Al-Hazzaa et., 2012]. A Chinese study conducted on children and adolescents between 5 and 18 years old found that the prevalence rates of obesity and overweight were 6.4% and 15.3%, respectively, and male were more commonly obese (9.5% vs. 3.1%) or overweight compared to female (17.5% vs. 12.9%) respectively [Guo et al. 2012].

Al-Hazzaa et al. (2018) observed that female adolescents were at a greater risk of inactivity and sedentary behavior than males. Multivariate logistic regression analysis of 868 children and adolescents aged 6–19 years in Lebanon showed that sedentary behavior and increased intake of sugar-sweetened drinks and fast food were correlated with an amplified risk of overweight, obesity, and abdominal adiposity, while consistent breakfast intake and increased consumption of dairy and added fats and oils were among the elements related to a reduced risk [Nasreddine et al. 2014]. Additionally, Al-Hazzaa et al. (2012) assessed how lifestyle factors affect the weight of adolescents aged 14–19 years in 3 main cities in the Kingdom of Saudi Arabia. Among all of the lifestyle elements measured, obesity and overweight were significantly related to a low frequency of vigorous PA and infrequent intake of vegetables, sugar-sweetened beverages, and breakfast. In the Kingdom of Saudi Arabia, a nation that has undergone rapid urbanization and nutritional changes in recent decades, it is estimated that 10.6% and 26.6% of adolescents between the ages of 13 and 18 years are obese or overweight, respectively [Al-Hazzaa et., 2012]. According to national data, in the Kingdom of Saudi Arabia, the prevalence of obesity was ≥10% greater among males than among females, while the prevalence of overweight was ≥10% greater among females [El Mouzan et al. (2010), Al-Mohaimeed et al. (2012), and Al-Muhaimeed et al. (2015)].

The main objectives were to (1) explore the most common lifestyle behaviours among female adolescents aged 12–16 years based on the WHO's BMI classes and (2) examine whether there are possible associations between lifestyle factors and BMI status.

2. Materials and methods

2.1. Study setting and participants

This study was a cross-sectional quantitative study and was conducted at 5 intermediate schools in the Eastern Province of Saudi Arabia. Ten governmental schools had been proposed by the Directorate of General Education of the Eastern Province – Dammam – Female Section to take part in this study. Five out of the ten schools were selected by convenience sampling.

The five schools were informed by the Directorate of General Education at Eastern Province – Dammam about the times and days of the month when the researchers would visit. Then, these five schools randomly selected a number of classes for data collection. The questionnaires were given to all students in each of the selected classes. There were 604 females aged 12-16 years. The research idea, objectives, and data integrity and security measures had been explained to the participants, and verbal consent was secured from the participants and their parents. All participants were also assured that they had the right to withdraw from the study at any time.

The inclusion criteria include: (1) adolescent female students at intermediate schools in the Eastern Province, (2) age 12 to 16 years, (3) Saudi. On the other hand, students with physical disabilities were excluded from the study.

2.2. Data collection methods

2.2.1. Questionnaire

The data were collected using a pre-validated questionnaire, the Arab Teens Lifestyle Study (ATLS), developed by Al-Hazzaa et al. (2011a). This questionnaire was selected due to its demonstrated satisfactory validity. The ATLS is a self-reported questionnaire and consists of 47 questions classified into four parts. The first part composed of 5 items representing demographic data, such as age, height, weight, and year in school; the second

part composed of 26 items related to PA; the third part composed of 6 items related to sedentary activities; the last part composed of 10 items related to food consumption. All questions had multiple-choice answers in a logical order. In this study, all questionnaire data were recorded by participants except height and weight, which were measured and recorded by trained researchers. A pilot study was conducted on 37 students to determine the extent of clarity and acceptance of the questionnaire. The results of the pilot study indicated that the questionnaires were clear and did not contain any ambiguous language. The pilot study was conducted on 20 students at one of the target schools, and the subjects in the pilot study were excluded from the main study.

2.2.2. Measurements of physical activity (PA)

Participants' PA was calculated based on the method presented by Al-Hazzaa et al. (2011a) in the ATLS questionnaire. This PA questionnaire included domains such as fitness and sports, transport and household activities. The PA was given metabolic equivalent of task (MET) values according to the compendium of PA and that of PA for young people.

The moderate-intensity PA examined in this study comprised recreational swimming, brisk walking, normal-pace walking, moderate-intensity recreational sports (for example, table tennis and volleyball), and household activities. These activities had MET values of 3–6 [Al-Hazzaa et al. (2011a) and Al-Hazzaa et al. (2011b)]. The vigorous PA considered in this study included cycling, jogging, stair climbing, self-defense, weight training and vigorous sports (for example, singles tennis, handball, soccer, and basketball). These activities had MET values of more than 6 [Al-Hazzaa et al. 2011a]. To quantify students' degrees of PA, we considered the total METs-min per week and the METs-min per week in performing the PA at moderate and vigorous intensity levels.

2.2.3. Anthropometric parameters

Students' weight (to the nearest 0.1 kg) and height (to the nearest 0.5 cm) were both assessed utilizing a stadiometer scale. The participants were wearing lightweight clothes and were asked to take off their shoes. The scale used to measure the participants' body weight (kilograms) was recalibrated to zero before each weighing. The height of each subject was also assessed after the weight measurement, and both height and weight were utilized to calculate the BMI of the female adolescents. The BMI categories being defined according to the standard BMI-for-age classification (i.e., thin, normal, overweight, and obese) for girls aged 5-19 years [WHO, 2018].

2.2.4. Eating habits and food consumption

The ATLS survey contains ten items intended to determine teenagers' habitual consumption of specific foods. The items reflect how many days per week a subject consumes sugar-sweetened drinks, breakfast, fruits, vegetables, milk and dairy foodstuffs, sweets (for example candy, cake, chocolate, and donuts), fast foods, and energy drinks. These items are able to capture a range of healthy and unhealthy nutritional habits. Possible responses ranged from 0 to extreme consumption of 7 days/week.

2.3. Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM, Chicago, Illinois, USA) was utilized for statistical analysis. Frequency and percentage were calculated as descriptive statistics. Inferential analysis was performed by ANOVA and post hoc LSD to determine whether there were any significant differences in female lifestyle factors based on BMI classes. Logistic regression analysis was performed to explore the correlations between BMI categories and lifestyle elements. BMI categories was the dependent variable, while the independent variables were lifestyle factors, age, body weight, body height, sedentary activities, PA, and food consumption.

The data were entered into a computer using the ATLS questionnaire computerization codes. For the PA data, METs-min was measured based on MET values provided by the WHO (shown in appendix A). Sedentary behavior, defined as screen time, other technology use, and sleep, was recorded in hours per day. Food consumption data were measured based on number of days per week. The BMI data were sorted manually into four categories

based on the WHO BMI chart. The categories were as follows: thinness (thinness + severely thinness, below -2 SD), normal weight (-2 SD to +1 SD), overweight (above +1 SD), and obese (obese + morbid obese, above +2 SD).

3. Results and discussion

3.1. Results

Overall, 604 female participants were involved in the current study. However, 6 questionnaires were excluded due to omission of essential data. The results showed that the mean age of the subjects was 13.85 ±0.96 years (between 12 and 16 years old), the mean body height was 153.84 ±8.79 cm, the mean body weight was 53.68 ±15.25 kg, and the mean BMI was 22.56 ±5.80 kg/m^2.

Table 1 showed that, according to the WHO (2018) BMI classes, 3.5% of subjects were underweight, 20.6% were overweight and 19.4% were obese. Only 56.6% of subjects had normal body weight.

Table 1. Frequency Distribution of Studied Subjects According to BMI Classes.

BMI classes	Frequency	Percent
Thinness (thinness + severely thinness; below -2 SD)	21	3.5
Normal (-2 SD to +1 SD)	338	56.5
Overweight (above +1SD)	123	20.6
Obese (obese + morbidly obese; above +2 SD)	116	19.4
Total	598	100.0

Table 2 shows the mean and standard deviation scores for demographic and lifestyle variables by BMI classes. Table 2 also reports the results of the ANOVA for significant differences among participants based on BMI classes in relation to lifestyle factors. The results showed significant variations ($P<0.05$) in female lifestyle factors based on BMI classes; these lifestyle factors comprised weight, BMI, vegetable consumption, French fries/potato chips consumption, cake and donut consumption, energy drink consumption, MET-min/week of swimming, MET-min/week of household tasks, and total PA (MET-min/week). By comparison with normal-weight individuals, overweight and obese individuals appeared to have significantly ($P < 0.05$) lower consumption of energy drinks, cake and donuts, and French fries/potato chips. Additionally, overweight and obese individuals seemed to have significantly ($P < 0.05$) higher consumption of vegetables than normal-weight subjects, but underweight subjects had the highest vegetable consumption of any group. Moreover, overweight and obese individuals appeared to be significantly ($P < 0.05$) more involved than other BMI categories in household activities and swimming compared. Obese subjects appeared to be involved significantly ($P < 0.05$) more than other classes in physical activities in that they performed the greatest total number of MET-min/week.

3.2. Discussion

The main objectives of the current study were to explore the most common lifestyle behaviors associated with WHO [2018] BMI categories among female adolescents aged 12–16 years and to examine possible correlations of overweight and obesity with lifestyle factors. The main result of the current study is the presence of significant differences in female lifestyle behaviors, mainly weight, vegetable consumption, fruit consumption, French fries/potato chips consumption, cake and donuts consumption, energy drink consumption, MET-min of swimming, and total PA (MET-min/week), among different BMI classes.

Regression analysis revealed that female adolescents had increased odds of being overweight/obese if they consumed fruit 3-4 days per week, consumed French fries/potato chips 3-4 days per week and/or consumed cake/donuts > 5 days per week. Consumption of fruit only 3-4 days per week may be insufficient to maintain a balanced diet. The recommended daily intake of fruits and vegetables is ≥ 5 portions [Spear et al. (2007) and Styne et al. (2017)]. According to Spear et al. [2007], and Styne et al. [2017] lifestyle modification is suggested as a first-line treatment approach for reducing childhood obesity. This approach includes increasing the consumption of fruit and vegetables, engaging in continuous PA, altering dietary intake, adopting healthy dietary habits, and decreasing the daily time allocated for using computers and viewing TV (Ismail et al., 2007).

Table 2. Mean and SD of Age, Anthropometric Indices, PA, Screen Time, and Food Consumption by BMI Categories in the Study Subjects.

Variable	Females				
	Thinness (n=21)	Normal (n=338)	Overweight (n=123)	Obese (n=116)	P-value
Age (years)	13.9±.9 [a]	13.9±1.0 [a]	13.9±1.0 [a]	13.7±.9 [a]	0.553
Weight (kg)	32.9±4.1 [a]	45.7±6.9 [b]	58.9±6.1 [c]	75.4±15.6 [d]	0.000
Height (cm)	150.2±7.0 [a]	154.0±6.9 [b]	154.4±6.2 [b]	154.4±9.0 [b]	0.095
BMI (kg/m^2)	14.5±0.9 [a]	19.2±2.0 [b]	24.7±1.5 [c]	31.5±5.5 [d]	0.000
Screen time (e.g. television watching etc. hours/day)	2.9±1.9 [a]	2.8±2.1 [a]	2.6±2.1 [a]	2.8±2.1 [a]	0.477
MET-min/week of moderate-intensity physical activity	150.5±181.5 [a]	129.6±383.5 [a]	164.6±392.3 [a]	142.7±270.2 [a]	0.832
MET-min/week of vigorous physical activity	397.0±717.9 [ab]	225.1±584.2 [a]	446.0±1335.6 [b]	272.7±547.2 [ab]	0.062
Total MET-min/week	3503.0±3484.1 [ab]	2386.4±2808.2 [a]	3379.6±4566.3 [b]	3691.0±4552.7 [b]	0.002
Breakfast consumption (times/week)	4.3±2.7 [a]	3.2±2.7 [a]	3.1±2.5 [a]	3.5±2.7 [a]	0.239
Vegetable consumption (times /week)	3.6±2.7 [ab]	3.3±2.5 [a]	4.1±2.5 [b]	3.4±2.5 [a]	0.018
Fruit consumption (times /week)	3.6±2.3 [ab]	3.1±2.3 [a]	3.6±2.3 [b]	3.5±2.3 [b]	0.054
Milk/dairy product consumption (times /week)	3.8±2.6 [a]	3.2±2.4 [a]	3.5±2.5 [a]	3.5±2.4 [a]	0.431
Sugar-sweetened drink consumption (times /week)	3.6±2.4 [a]	3.2±2.4 [a]	3.1±2.5 [a]	2.8±2.4 [a]	0.413
Fast food consumption (times /week)	3.4±2.1 [a]	2.7±2.0 [ab]	2.4±1.7 [b]	2.4±1.9 [b]	0.056
French fry/potato chip consumption (times /week)	4.0±2.6 [a]	2.8±1.9 [b]	2.3±1.8 [c]	2.5±2.1 [bc]	0.001
Cake/donut consumption (times /week)	4.00±2.2 [a]	3.1±2.2 [a]	2.5±2.1 [b]	2.5±2.1 [b]	0.003
Sweet consumption (times /week)	3.9±2.8 [a]	3.6±2.4 [a]	3.5±2.4 [a]	3.2±2.4 [a]	0.495
Energy drink consumption (frequency/week)	1.7±2.1 [a]	0.9±1.6 [b]	0.6±1.2 [b]	0.7±1.4 [b]	0.008
Swimming (MET-min/week)	648.6±168.4 [a]	209.6±536.6 [b]	404.6±1116.5 [b]	400.4±945.5 [b]	0.010
Household tasks (MET-min/week)	2.6±2.6 [ab]	3.0±2.6 [a]	3.5±2.8 [b]	3.4±2.8 [ab]	0.029

P-value calculated by ANOVA and post hoc least significant difference (LSD) test
Different superscript letters in the same row indicate significant differences between values (P<0.05).
Table 3 showed the results of logistic regression analysis. The coefficient β revealed that the following health-related variables were significantly correlated with overweight and obesity: consuming fruit 3-4 days/week (odds ratio [OR] = 1.669; 95% confidence interval [CI] = 1.032-2.697, P = 0.037), eating French fries/potato chips 3-4 days/week (OR = 1.936; 95% CI = 1.206-3.110, P = 0.006), and consuming cake > 5 days/week (OR = 2.261; 95% CI = 1.361-3.757, P = 0.002).

Table 3. Associations between Lifestyle Factors and Overweight/Obesity.

Model	β	SE	P	OR	(95% CI)
Breakfast intake ≥ 5 days/week					
< 3 days/week	-.141	.201	.483	.868	(.585-1.288)
3 – 4 days/week	.035	.277	.901	1.035	(.602-1.780)
Sugar-sweetened drink intake < 5 days/week					
3 – 4 days/week	.116	.223	.602	1.123	(.725-1.740)
≥ 5 days/week	.013	.239	.958	1.013	(.634-1.618)
Vegetable intake ≥ 5 days/week					
< 3 days/week	.290	.221	.189	1.337	(.867-2.062)
3 – 4 days/week	.101	.262	.701	1.106	(.661-1.850)
Fruits intake ≥ 5 days/week					
< 3 days/week	.416	.229	.069	1.516	(.968-2.374)
3 – 4 days/week	.512	.245	.037*	1.669	(1.032-2.697)
Milk intake ≥ 5 days/week					
< 3 days/week	-.008	.212	.970	.992	(.655-1.504)
3 – 4 days/week	-.178	.255	.485	.837	(.508-1.379
Fast food intake < 5 days/week					
3 – 4 days/week	.107	.228	.637	1.113	(.712-1.741)
≥ 5 days/week	.367	.275	.183	1.443	(.842-2.474)
French fries/potato chips intake < 5 days/week					
3 – 4 day/week	.661	.242	.006**	1.936	(1.206-3.110)
≥ 5 days/week	.407	.265	.124	1.502	(.894-2.525)
Cake intake < 5 days/week					
3 – 4 days/week	-.015	.247	.951	.985	(.606-1.600)
≥ 5 days/week	.816	.259	.002**	2.261	(1.361-3.757)
Sweet intake ≤ 5 days/week					
3 – 4 day/week	-.137	.249	.582	.872	(.535-1.421)
> 5 days/week	-.334	.245	.174	.716	(.443-1.158)
Television watching ≤ 2 hours/day					
2 – 5 hours/day	-.031	.198	.876	.970	(.658-1.428)
> 5 hours/day	-.165	.280	.557	.848	(.490-1.469)
Internet use ≤ 2 hours/day					
2 – 5 hours/day	-.068	.228	.766	.934	(.597-1.462)
> 5 days/week	-.394	.249	.113	.674	(.414-1.097)
Constant	-.135	.275	.624	.874	

* P<0.05, and ** P<0.01

The current study indicated that overweight/obesity was correlated with consumption of cake/donuts > 5 days/week and intake of French fries/potato chips 3-4 days per week. In terms of BMI classes for adolescent females, these results were nearly equivalent to the results published by Al-Hazzaa et al. (2012).

The results of the current study indicated that the screen time ranged between 2.6 and 2.9 hours per day, which exceeded the maximum of 2 hours per day recommended by the guidelines of Canadian Sedentary Behavior Research for adolescents 12–17 years of age [Tremblay et al. 2017].

The literature highlights the association between sedentary behavior such as screen viewing time and overweight and obesity in adolescents [O'Brien et al. 2018]. However, very few studies carried out in countries other than Saudi Arabia showed any significant relationship between overweight or obesity and screen time. Although the mean screen time of overweight/obese adolescent Saudi females in Al-Hazzaa et al. (2012) study was more than (6.5 hr./day) the amount observed in the current study (2.7 hr./day), but Al-Hazzaa et al. (2012) results support the absence of a significant association between overweight/obesity and screen time among adolescent Saudi females, which is in good agreement with the results of the current study. This lack of association may be a general trend among this group in Saudi Arabia.

In the study by Al-Hazza et al. (2012), overweight/obesity was correlated with low PA levels. The findings of that study highlight the significant role of PA (mainly at a vigorous level) in preventing obesity among teenagers. The

results of the current study are in accordance with such growing evidence that PA is a major issue in obesity throughout childhood and adolescence.

The relationship between screen time and overweight/obesity may be explained by the possibility that screen time displaces PA time, increases calorie consumption and diminishes resting metabolism [Robinson et al. 1993].

The results from a cross-sectional study of 10- to 16-year-old adolescents in 34 countries showed that overweight adolescents had lower PA levels and spent more time watching TV than normal-weight adolescents did [Janssen et al. 2005].

A study on a group of 11- to 15-year-old adolescents from the United States revealed that overweight was significantly related to vigorous PA but not moderate-intensity PA. Moreover, a significant negative relationship was noted between vigorous PA and total body fat among Spanish individuals [Moliner-Urdiales et al. 2009].

Furthermore, a study of the impact of PA on obesity in a population aged 5–18 years revealed that more time allocated to vigorous PA resulted in a decline in obesity and an increase in aerobic capacity [Parikh and Stratton, 2011].

It seems that not all screen-based activities have equivalent relationships with adolescent overweight or obesity; a study carried out on Australian adolescents revealed that video games and computer use were not major risk factors for overweight and obesity [Burke et al. 2006].

Of all nutritional habits measured in the current study, the factors that significantly increased the odds of overweight and obesity were infrequent intake of fruit and high weekly consumption of French fries/potato chips, cake, and donuts. The findings of this study agreed with those of previous studies. Certainly, missing breakfast is a major predictor of overweight and obesity among adolescents from numerous countries [Deshmukh-Taskar et al. (2010) and, Duncan et al. (2011)]. Nevertheless, in Canadian adolescents, no obvious relationship between overweight/obesity and nutritional habits was observed [Janssen et al. 2004]. The present study found that there was no significant inverse relationship between frequent intake of sugar-sweetened drinks and measures of overweight or obesity. This finding disagrees with other studies, which have stated that high intake of sugar-sweetened drinks is correlated with obesity in children [Ludwig et al. 2001].

4. Conclusions

This study determined the association of BMI with several lifestyle variables among female Saudi adolescents aged 12–16 years. A significant positive association was found between BMI categories and factors such as intake of French fries/potato chips and frequent consumption of cake/donuts. In addition, overweight and obese subjects consumed fruit on fewer days per week than normal-weight subjects did. Primary prevention is needed in the form of a healthy diet and physical activity in adolescence, which can diminish the risk of obesity and support females in attaining a healthier body composition prior before they progress to childbearing age.

Recommendations

The authors recommend that (1) school cafeterias should provide healthier food items than they currently do, (2) parents' awareness of obesity and its risk factors, as well as healthy adolescent lifestyles, should be increased, (3) girls' intermediate schools should provide mandatory physical education classes, (4) school intervene to promote healthy lifestyle behavior, (5) schools must provide infrastructure that allows the students to engage in proper physical activity and (6) adolescents should be encouraged to adopt a healthy lifestyle in all aspects.

Ethics and limitations

Ethical approval

This research was ethically approved by an Institutional Review Board (IRB) at Imam Abdulrahman Bin Faisal University (IRB-UGS-2018-03-041). A second approval was obtained from the Directorate of General Education at Eastern Province – Dammam – Female Section for data collection in intermediate schools in the Eastern State.

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