Determinant of overweight and obesity among females' adolescents in the Eastern Province of Saudi Arabia, Cross-Sectional Study

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Research

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Abstract

Background: several lifestyle factors related to adolescent overweight and obesity have been well documented. The main objectives of this study were to explore the common lifestyle behaviors among female adolescents based on body BMI category and to examine the association between overweight/obesity and lifestyle factors among them.

Methods: cross-sectional study was carried out on 598 participants, and Arab Teens Lifestyle Study (ATLS) questionnaire was used. Data related to lifestyle factors, e.g., physical activity, metabolic equivalent rate, sedentary behavior; dietary consumption; and anthropometrics including height, weight, and BMI were collected. To test the correlations between BMI and lifestyle factors, ANOVA and logistic regression were performed.

Results: based on BMI, 20.6% and 19.4% of females suffer from overweight and obesity, respectively. Results indicated significant differences ($P<0.05$) in several female anthropometric factors and lifestyle behaviors based on BMI category. These factors comprised BMI, weight, consumption of French fries/potato chips, vegetables, fruits, and cake/donuts; and MET-min of swimming, 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 (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 category and factors such as eating French fries/potato chips and cakes/donuts were observed among adolescent Saudi females.

Background

Adolescence is considered a high-risk stage for changes in body weight, as it is a period of developmental plasticity [1, 2]. It was estimated that in 2010, 35 million adolescents and children in developing countries were overweight and obese [3]. 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 [4]. 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 [5]. 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 [2]. 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 [6]. 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 [7].

Al-Hazzaa et al. [6] observed Arab adolescents aged 14 to 19 years and found that female adolescents were at a greater risk of inactivity and sedentary behavior than males were [8]. Multivariate logistic regression analyses 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 [9]. Additionally, Al-Hazzaa et al. [6] 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 [6]. 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 [10–12].

The main objectives were as follows:

1 – To explore the most common lifestyle behaviours among female adolescents aged 12–16 years based on the WHO's BMI classification.

2 – To examine whether there are possible associations between lifestyle factors and BMI status.

Methods

Research design

This investigation was a cross-sectional quantitative study.

Study setting

This survey was conducted at 5 intermediate schools in the Eastern Province of Saudi Arabia.

Participants

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.

Inclusion criteria

1 – Adolescent female students at intermediate schools in the Eastern Province.

2 – Aged 12 to 16 years.

Exclusion criteria

1 – Any adolescent female students at intermediate schools in the Eastern province with physical disabilities.

Data collection methods

Questionnaire

The data were collected using a pre-validated questionnaire, the Arab Teens Lifestyle Study (ATLS), developed by Al-Hazzaa et al. [13]. This instrument was selected due to its demonstrated satisfactory validity. The ATLS is a self-reported questionnaire that includes 47 questions classified into 4 parts. The first part contains 5 items representing demographic data, such as age, height, weight, and year in school; the second part contains 26 items related to PA; the third part contains 6 items related to sedentary activities; the last part contains 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 at one of the target schools, and the subjects in the pilot study were excluded from the main study.

Measurements of physical activity (PA)

Participants' PA was calculated based on the method presented by Al-Hazzaa et al. [13] 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 [13,14]. 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 [13]. 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.

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 [15].

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.

Statistical analysis

Age and sex, the major two confounders has been controlled as the age of all participants were ranged from 12 to 16 years old, and all of participants were females.

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 to determine whether there were any significant differences in female lifestyle factors based on BMI classes. Logistic regression was performed to explore the correlations between BMI category and lifestyle elements. BMI category 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).

Results

Overall, 604 female participants were involved in the current study. However, 6 questionnaires were excluded due to omission of essential data. The participants' characteristics are reported in Table 1. As shown in the table, 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. The mean ± SD of age and anthropometric measurements for participants

Variable	Females (n = 598)
Age (years)	13.85 ± 1.0
Weight (Kg)	53.7 ± 15.3
Height(cm)	153.8 ± 8.8
BMI(kg/m²)	22.6 ± 5.8

Table 2 shows that, according to the WHO [15] BMI classification, 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 2. Frequency distribution of studied subjects according to BMI classes

BMI classification	Frequency	Percent
Thinness (thinness + sever thinness) (less than − 2 SD)	21	3.5
Normal (more than − 2SD up to less or equal 1SD)	338	56.5
Overweight (more than 1SD)	123	20.6
Obese(obese + morbid obese)(more than 2SD)	116	19.4
Total	598	100.0

Table 3 shows the mean and standard deviation scores for demographic and lifestyle variables by BMI class. Table 3 also reports the results of the ANOVA for significant differences among participants based on BMI classifications 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 fry and potato chip 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). Compared with normal-weight individuals, overweight and obese individuals appeared to have significantly ($P < 0.05$) reduced consumption of energy drinks, cake and donuts, French fries and 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.

Table 3

Mean and SD for age, anthropometric indices, physical activity, screen time, and food consumption with regard to BMI category for studied subjects.

Variable	**Females**				
	Thinness	Normal	Overweight	Obese	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/m2)	14.5 ± 0.9 [a]	19.2 ± 2.0 [b]	24.7 ± 1.5 [c]	31.5 ± 5.5 [d]	0.000
Screen time (i.e. TV viewing and computer use) (hour/day)	2.9 ± 1.9 [a]	2.8 ± 2.1 [a]	2.6 ± 2.1 [a]	2.8 ± 2.1 [a]	0.477
METs-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
METs-min/week of Vigorous –intensity 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 METs-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 (frequency/week)	4.3 ± 2.7 [a]	3.2 ± 2.7 [a]	3.1 ± 2.5 [a]	3.5 ± 2.7 [a]	0.239
Vegetables Consumption (frequency/week)	3.6 ± 2.7 [ab]	3.3 ± 2.5 [a]	4.1 ± 2.5 [b]	3.4 ± 2.5 [a]	0.018
Fruits Consumption(frequency/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 products intake (frequency/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 drinks (frequency/week)	3.6 ± 2.4 [a]	3.2 ± 2.4 [a]	3.1 ± 2.5 [a]	2.8 ± 2.4 [a]	0.413

P value calculated by ANOVA and follow up LSD test

Values subscribed with different letters in the same row showed significant differences between these values ($P < 0.0.5$).

Variable	Females				
Fast foods (frequency/week)	3.4 ± 2.1 [a]	2.7 ± 2.0 [ab]	2.4 ± 1.7 [b]	2.4 ± 1.9 [b]	0.056
French fries/potato chips (frequency/week)	4.0 ± 2.6 [a]	2.8 ± 1.9 [b]	2.3 ± 1.8 [c]	2.5 ± 2.1 [bc]	0.001
Cake/donuts (frequency/week)	4.00 ± 2.2 [a]	3.1 ± 2.2 [a]	2.5 ± 2.1 [b]	2.5 ± 2.1 [b]	0.003
Sweets (frequency/week)	3.9 ± 2.8 [a]	3.6 ± 2.4 [a]	3.5 ± 2.4 [a]	3.2 ± 2.4 [a]	0.495
Energy drinks (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 METs-min/week	648.6 ± 168.4 [a]	209.6 ± 536.6 [b]	404.6 ± 1116.5 [b]	400.4 ± 945.5 [b]	0.010
House holding METs-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 follow up LSD test					
Values subscribed with different letters in the same row showed significant differences between these values (P < 0.0.5).					

Table 4 shows 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 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 4
Associations between lifestyle factors and overweight/obesity

Model	β	SEE	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 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' 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)
Cakes 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					

* P < 0.05, and ** P < 0.01

Model	β	SEE	P	OR	(95%CI)
3–4 day/week	− .137	.249	.582	.872	(.535-1.421)
> 5 days/week	− .334	.245	.174	.716	(.443-1.158)
TV 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)
Net using ≤ 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					

Discussion

The main objectives of the current study were to explore the most common lifestyle behaviors associated with WHO [15] 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 and potato chip 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 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 [16, 17]. According to Styne et al. [16] and Spear et al. [17], 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.

The current study indicated that overweight/obesity was correlated with consumption of cake/donuts > 5 days/week and intake of French fries 3–4 days per week. In terms of BMI classification for adolescent females, these results were nearly equivalent to the results published by Al-Hazzaa et al. [6].

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 [18].

The literature highlights the association between sedentary behavior such as screen viewing time and overweight and obesity in adolescents [19]. 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 aged 15 to 17 in the study by Al-Hazzaa et al. [6] was more than twice (6.5 vs 2.7 hr./day) the amount observed in the current study, their results support the absence of a significant association between overweight/obesity and screen time among adolescent Saudi females, which is in 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. [6], 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 [20].

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 [21].

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 [22].

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 [23].

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 [24].

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 [25, 26]. Nevertheless, in Canadian adolescents, no obvious relationship between overweight/obesity and nutritional habits was observed [27]. 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 [28].

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 category and factors such as intake of potato chips and French fries 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

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 – We suggest school educational interventions to promote healthy lifestyle behavior.

5 – Schools must provide infrastructure that allows the students to engage in PA.

6 – Adolescents should be encouraged to adopt a healthy lifestyle in all aspects.

Supporting information

Title: METs values based on WHO

ACTIVITY	MET value	Formula
moderate walking	2.5	Frequency* 2.5 + minutes
brisk walking	3.3	Frequency* 3.3 + minutes
jogging & running	8	Frequency* 8 + minutes
cycling	7	Frequency* 7 + minutes
swimming	6	Frequency* 6 + minutes
moderate intensity sports	4	Frequency* 4 + minutes
vigorous-intensity sports	8	Frequency* 8 + minutes
self-defense	7	Frequency*7 + minutes
weight training (resistance training or calisthenics)	6	Frequency* 6 + minutes
household activity	3	Frequency* 3 + minutes
Dancing	5.5	Frequency* 5.5 + minutes
stair steps	8	Frequency\3* 8 + minutes

Abbreviations

ATLS: The Arab Teens Lifestyle Study

MET: Metabolic Equivalent of Task

OR: Odds Ratio

CI: Confidence Interval

PA: Physical Activity

VPA: Vigorous Physical Activity

MVPA: Moderate to Vigorous Physical Activity

Declarations

Limitation of the study

One of the main limitations is that all the participants in this study were female adolescents. Therefore, we recommend the inclusion of male students in future studies to allow comparison of BMI-related factors between genders.

Ethics approval and consent to participate

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.

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.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare to have no competing interests.

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Authors' contributions

1. Al-Qahtani and M. Ismail designed the study; M. Al-Qahtani, A. Alghareeb and Z. Alramadan performed the study and collect the data; M. Al-Qahtani analyzed the data; M. Ismail and M. Al-Qahtani wrote the paper.

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