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ORIGINAL RESEARCH

Lifestyle Behaviors and Socio-Demographic Factors Associated with Overweight or Obesity Among Saudi Females Attending Fitness Centers

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Objective: To examine the associations of overweight or obesity with several lifestyle and socio-demographic factors among Saudi women attending fitness centers in Riyadh.

Methods: Saudi females (n = 460) aged 16 years and older were recruited from 12 randomly selected fitness centers in Riyadh, using a stratified clustered sampling technique. Bodyweight and height were measured. Lifestyle behaviors were assessed using a previously validated instrument, and included physical activity, sedentary behaviors, sleep, and dietary habits.

Results: Over 62% of the participants were either overweight or obese. Mean BMI values for females younger than age 30 years (26.4 ± 5.3) were significantly lower than those 30 years of age or older (29.2±5.6, p >0.001). There was a significant correlation (r = 0.450, p < 0.001) between BMI levels and the participant's reason to engage in exercise for weight loss. Females who were overweight/obese are significantly older, married, have more children, have a lower educational degree, earn less income, have higher numbers of obese in the family, and had attempted to lose weight more frequently than non-overweight/non-obese females. No significant differences were detected between females who were overweight/obese and those who were not overweight/obese in the majority of the lifestyle-related variables, except that females who were not overweight or obese showed lower weekly consumption of milk and dairy products (p =0.029) and higher intakes of fast foods per week (p =0.049).

Conclusion: Weight loss attempts, age, number of obese in the family, and females' education level emerged as the most important contributory factors to obesity status, explaining nearly 23% of the common variances. A better understanding of the relationships between obesity and lifestyle behaviors is necessary for effective prevention and management of obesity in Saudi females.

Keywords: body mass index, fitness center, lifestyle behaviors, obesity, socio-demographic factors

Introduction

The prevalence of overweight and obesity appears to be rising in many countries worldwide.[1,2] Obesity is a major health concern and has been reported to be associated with increased risk of diabetes, hypertension, hyperlipidemia, obstructive sleep apnea, and osteoarthritis.[3,4] Moreover, obesity in women in particular is considered a multifactorial condition influenced by many modifiable and non-modifiable variables.[2,5,6] Strong positive associations have been reported between overweight or obesity and several unhealthy lifestyle behaviors such as television viewing and

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physical inactivity, which highlights the potential benefits of reducing sedentary behaviors, and increasing physical activity, in combating a surge in obesity rate.[7] In addition, lifestyle -related risks appear to be linked to many non-communicable diseases (NCDs), with enormous global mortality and economic cost.[8] For instance, a sedentary lifestyle has been reported to be adversely associated with cardiovascular and metabolic risk factors, including body mass index (BMI), waist circumference, systolic blood pressure, fasting triglycerides, HDL cholesterol, 2-hour glucose test, and fasting insulin.[9] On the other hand, ample evidence has shown significant associations between a healthy lifestyle and improved health and well-being.[10,11]

A recent review of systematic reviews conducted on lifestyle-related diseases among women in the Gulf Cooperation Council (GCC) countries, including Saudi Arabia, showed high levels of modifiable risk factors among women.[12] The study highlighted the need for comprehensive work among the GCC states to strengthen the regulatory framework and endorse social and political changes in order to reduce such risk factors.[12] Results from a national survey conducted in 2013 indicated that the prevalence of overweight plus obesity among Saudi women 16–64 years was 61.5%, with obesity found to be higher among less-educated men and women.[13] In the past, obesity among Saudi women was a sign of prosperity and affluence; however, it is seen now as a health problem and a risk factor for many non-communicable diseases. This change in perception of obesity among young women may be attributed to increased women's education, improved health care in the country, and more trends toward globalization.[14]

In Saudi Arabia, there have been positive socio-political changes recently that have provided more autonomy and opportunities for Saudi women to participate in many aspects of society. The country introduced physical education for girls in schools in 2017, permitted women to drive in 2018, and also began granting licenses to open private gyms for women, allowing more opportunities for women to be physically active. Such recent changes are applauded, especially when the national prevalence of no or insufficient physical activity among Saudi women was reported to be nearly 78%.[15,16] Similar figures among female youths were reported.[17,18] The high inactivity level among Saudi females coupled with high screen time represents a double burden on the health of young Saudi women.[17] Community-based lifestyle intervention has been shown as an appropriate format for weight management and appears to improve bodyweight, anthropometric, and fitness parameters.[19] In addition, recent reports have stressed the importance of local community fitness centers, through referral systems, in promoting physical activity and thus helping to prevent coronary heart disease risk factors, including obesity indices, fat distribution, plasma lipids, inflammation, psychological problems, and overall morbidity and mortality.[20]

In the current article, we present findings on the associations between overweight/obesity and lifestyle behaviors among Saudi females attending fitness centers in Riyadh, using a previously validated lifestyle behaviors questionnaire.[17,21] More specifically, we examined the differences in selected socio-demographic factors and lifestyle behaviors between females who were overweight or obese and those who were not overweight or obese who were participating in fitness centers.

Methods

Participants

Saudi females aged 16 years and older without any physical impairment were recruited from 12 randomly selected fitness centers in Riyadh, Saudi Arabia, using a stratified (geographical locations) clustered sampling technique. A predetermined sample size of 384 participants was calculated so that the sample proportion was within 0.05 of the population proportion with a 95% confidence level. Population proportion was assumed to be at 0.50, as this proportion yields the maximal possible sample size required. We then added about 20% for clustered design effects and missing data, and the total target sample size reached 460 females. Female participants in the sampled fitness center were approached during random visits and were asked to take part in the study. Visits to the fitness centers included random days during the week and over weekends. The ethical approval was secured from the ethical committee at the Health Sciences Research Center, Princess Nourah University (IRB Log Number: 18–0222). A written consent form was obtained from each of the participating females. All participants were informed about the purpose of the study. In addition, the study was conducted in accordance with the Declaration of Helsinki.

Anthropometric Measurements

Bodyweight was measured to the nearest 100 g, with minimal clothing, and without shoes, using a calibrated

portable medical scale (Seca scale model 770, Seca, Hamburg, Germany). Height was measured to the nearest cm with the subject in the full standing position without shoes using a calibrated portable measuring rod. Body mass index (BMI) was calculated as bodyweight in kg divided by squared height in meters. Participants were classified into two categories, overweight/obesity (BMI =/> 25 kg/m^2) or non-overweight/non-obesity (BMI < 25 kg/m2). An underweight category was classified as BMI values below 18.5 kg/m^2.

Assessment of Lifestyle Habits

The Arab Teen Lifestyle Study (ATLS) questionnaire was used to collect data related to physical activity, screen time, sleep duration, and dietary habits.[17,21] Briefly, the questionnaire collects information on the frequency, duration, and intensity of light, moderate, and vigorous intensity physical activities during a typical week. The items cover several domains of activity including transport, household, fitness and sporting, and leisure-time activities. The questionnaire was shown in previous studies to be valid and reliable for assessing physical activity and other lifestyle habits in adolescents and young adults.[22,23] In addition, participants reported on the typical time in hours spent per day on screen activities, including television (TV) viewing, video games, and computer and internet use during both weekdays and weekends. The weekly dietary habits, as well as typical duration (in hours) of sleep at night on weekdays and weekends, were also reported by the participants.

Data and Statistical Analysis

Data were entered into an SPSS data file, checked, cleaned, and analyzed using SPSS program, version 22 (IBM, Chicago, IL). Descriptive statistics were calculated and presented as means and standard deviations (SD) or proportions. In addition, cross-tabulation with Chi-square tests was used to calculate the frequency and proportion of selected sociodemographic variables relative to overweight or obesity status. Multivariable analysis was used to test differences between overweight/obese versus non-overweight/non-obese participants as well as differences between younger versus older age groups in selected variables while controlling for several confounders. Spearman correlation coefficient was calculated between BMI levels and the participant's reason to do exercise for weight loss. Finally, a linear regression analysis with a stepwise method was used to predict BMI. Variables entered into the prediction equation included age, marital status, screen time, sleep duration, education level, father's education, mother's education, family income, weight-loss attempt, number of obese in the family, sum of energy expenditure in METs from moderate-intensity physical activity, sum of energy expenditure in METs from vigorous-intensity physical activity, and total energy expenditure in METs from all physical activity. An alpha level of ≤0.05 was used as the level of significance.

Results

After approaching 517 female participants during both weekdays and weekends, 460 of them agreed to take part in the study. This was a response rate of 89%. About 60% of the sample were younger than 30 years of age. The anthropometric characteristics of the participating females as a whole and relative to overweight/obesity status are shown in Table 1. Over 62% of the participants are either overweight or have obesity. Only 2% of the females are underweight. Mean BMI values for those females younger than age 30 years are

Table 1 Anthropometric Characteristics of the Participating Females (Mean ± Standard Deviation or Percentage)

Variables	N	All	Non-Overweight/Non-Obese	Overweight/Obese
Age (year)	409	29.2 ± 8.2	26.8 ± 6.0 *	30.6 ± 8.9
Weight (kg)	455	69.3 ± 14.3	56.9 ± 5.7 *	76.7 ± 12.7
Height (cm)	455	158.7 ± 5.5	159.1 ± 4.9	158.5 ± 5.8
Body mass index (kg/m^2)	455	27.5 ± 5.4	22.5 ± 2.0 *	30.5 ± 4.6
Body mass index classification (%)				
<18.5 Underweight 2.0	18.5–24.9 Normal weight 35.5		25–29.9 Overweight 34.4	30+ Obesity 28.1
p < 0.001				

Note: *p < 0.001 for the difference between the non-overweight/non-obese and overweight/obese (t-test for independent samples).

significantly lower than those who were 30 years of age or older (26.4 ± 5.3 versus 29.2 ± 5.6, $p > 0.001$). Also, overweight or obesity status among the younger age group (53.3%) is significantly ($p < 0.001$) lower than those of the older age group (76.4%). There was a significant correlation (not shown in the table) between BMI levels and the participant's reason to engage in exercise for weight loss (r = 0.450, $p < 0.001$).

Table 2 describes the socio-demographic factors of the participants relative to overweight or obesity status. Females who were overweight or obese are significantly (p = 0.001–0.039) older, married, have more children, have lower educational degrees, earn less income, have higher numbers of obesity in the family, and had attempted to lose weight more frequently than those of non-overweight or non-obese participants.

Table 3 presents the results of the multivariable analysis of selected lifestyle variables among Saudi females relative to overweight or obesity status, while controlling for the effects of age, education level, family income, and father's and mother's education levels. There were no significant differences between females who were overweight or obesity versus those who were not overweight or obese in the majority of the lifestyle-related variables. As an exception to that, females who were not overweight or obese showed lower weekly consumption of milk and dairy products (4.3 ± 2.4 versus 4.8 ± 2.3 days/week, p = 0.029) as well as higher intakes of fast foods per week (1.9 ± 1.5versus 1.4 ± 1.3 days/week, p = 0.049), whereas females who were overweight or obese had a higher number of weight-loss attempts (1.9 ± 0.80 versus 2.5 ± 0.65, p = 0.011).

Table 4 shows the results of the multivariable analysis of selected anthropometric and lifestyle variables, while controlling for the effects of education level, family income, and father's and mother's education levels, among Saudi females relative to age group category. The older age group showed significantly higher values of bodyweight ($p < 0.001$), BMI ($p < 0.001$), vegetable intake ($p < 0.001$), and number of attempts to lose weight (p = 0.014), whereas the younger age group exhibited higher values of screen time ($p < 0.001$), sleep duration (p = 0.013), and intake of sugar-sweetened drinks (p = 0.023), fast foods ($p < 0.001$), French fries and potato chips ($p < 0.001$), and energy drinks (p = 0.001).

Table 5 displays the proportion (%) of inactive or active female participants (in METs-min/week) relative to overweight or obesity status. There was no significant difference in the prevalence of active participants between overweight or obesity (93.1%) versus non-overweight non-obesity (94.6%) status (p = 0.329). The majority of the women were relatively active irrespective of overweight or obesity status.

Table 2 Cross Tabulation of Socio-Demographic Variables Relative to Overweight or Obesity Status Among Saudi Females

Variables	Non-Overweight/ Non-Obese	Overweight/ Obese	p-value*
Age (years) (%)			
<30 years	46.7	23.6	< 0.001
≥30 years	53.3	76.4	
Marital status (%)			
Single	70.5	48.6	< 0.001
Married	29.5	51.4	
Number of children in family (%)			
1–2	50.0	31.1	0.039
3–4	41.7	43.7	
5+	8.3	25.2	
Educational level (%)			
High school or less	13.8	26.5	0.008
University degree	80.0	68.4	
Postgraduate degree	6.3	5.1	
Father's education (%)			
High school or less	36.1	41.6	0.077
University degree	42.2	44.9	
Postgraduate degree	21.7	13.5	
Mother's education (%)			
High school or less	55.3	65.3	0.110
University degree	37.9	30.0	
Postgraduate degree	6.8	4.7	
Family income in SR (%) **			
≤10,000	13.5	21.8	0.038
10,001–20, 000	40.0	41.0	
20,001–30,000	23.9	23.8	
>30,000	22.6	13.4	
Number of obese members in the family (%)			
None	77.3	56.5	0.002
1–2	21.2	37.0	
3+	2.5	6.5	
Weight loss attempt (%)			
None	43.1	14.3	< 0.001
1–2	31.2	28.8	
3+	25.7	56.9	

Notes: *Chi-square tests for the differences in proportions. **US$ = 3.75 Saudi Riyal.

Table 3 Multivariable Analysis of Selected Lifestyle Variables, While Controlling for Age, Education Level, Family Income, and Father's and Mother's Education Levels, Among Saudi Females Relative to Overweight or Obesity Status (Data are Means and Standard Deviations)

Variables	Non-Overweight/Non-Obese	Overweight/Obese	p-value *
Screen time (hours/day)	4.5 ± 2.0	4.4 ± 2.3	0.292
Sleep duration (hours/night)	6.6 ± 1.6	6.8 ± 1.5	0.063
Sum of activity energy expenditure from moderate intensity physical activity (METs-min/week)	1425.2 ± 1435.5	1598.6 ± 1270.9	0.642
Sum of activity energy expenditure from vigorous intensity physical activity (METs-min/week)	2450.7 ± 2300.1	2112.2 ± 2005.5	0.212
Total activity energy expenditure from all physical activity (METs-min/week)	3875.9 ± 2967.9	3710.8 ± 2510.2	0.449
Breakfast intake (day/week)	4.6 ± 2.6	4.6 ± 2.7	0.889
Vegetable intake (day/week)	4.6 ± 2.1	4.8 ± 2.1	0.861
Fruit intake (day/week)	3.5 ± 2.3	3.9 ± 2.2	0.151
Milk & dairy products intake (day/week)	4.3 ± 2.4	4.8 ± 2.3	0.029
Sugar-sweetened drinks intake (day/week)	1.7 ± 2.0	1.4 ± 1.8	0.554
Fast foods intake (day/week)	1.9 ± 1.5	1.4 ± 1.3	0.049
French fries/potato chips intake (day/week)	1.5 ± 1.5	1.2 ± 1.3	0.292
Cake/donuts intake (day/week)	2.0 ± 1.8	1.9 ± 1.8	0.900
Chocolates/candy intake (day/week)	3.1 ± 2.3	2.6 ± 2.2	0.168
Energy drink intake (day/week)	0.20 ± 0.72	0.07 ± 0.50	0.204
Weight loss attempts	1.9 ± 0.80	2.5 ± 0.65	0.011

Note: * Wilks' Lambda F = 5.775, $p < 0.001$; *p*-values for tests of between-subjects effects are presented in the table.
Abbreviation: METs-min/week, metabolic equivalent in minutes per week.

Finally, the results of multiple linear regression analyses for the prediction of body mass index from the lifestyle and demographic factors are presented in Table 6. The findings showed four significant prediction models with adjusted R square ranging from 0.129 (weight loss attempts) to 0.226 (four independent predictors explaining nearly 23% of the variance in the participants' BMI values).

Discussion

In the present study, we examined the associations of overweight or obesity with several lifestyle and socio-demographic factors among Saudi women, who were randomly selected from participants attending fitness centers in Riyadh, the capital of Saudi Arabia. The main findings of the current study indicated that the majority (62%) of the sampled females are overweight or obese seeking mostly weight loss, yet they were fairly highly active in terms of total activity energy expenditure per week. The findings also showed that females who were overweight or obese are significantly older, married, have more children, have a lower educational degree, earn less income, have higher numbers of obesity in the family, and had attempted to lose weight more frequently than those females who were not overweight or obese. In addition, there was no significant difference in activity levels between overweight or obesity versus non-overweight non-obesity status. The most important contributory factors to obesity status (predicting BMI value) were weight-loss attempts, age, number of obesity in the family, and female's education level, explaining about 23% of the common variances.

Few studies have examined obesity prevalence in relation to lifestyle behaviors and demographic factors among females participating in fitness centers in Saudi Arabia.[24] The reason may be that until recently not many fitness centers were available for Saudi females. However, after the recent socio-political changes in the country, Saudi women began engaging on a large scale in exercise and physical activity at the newly opened fitness centers around the kingdom.[25] Compared with the previous study,[24] the present research used a large and representative sample from all the fitness centers in Riyadh. In addition, it used a validated questionnaire to examine the lifestyle behaviors among those participating females.

The overweight plus obesity prevalence among the present sample of females attending fitness centers reached 62.5%. In comparison, the prevalence rates for overweight and obesity in a study conducted in the Hail region in Northern Saudi Arabia were 22.5% and 70%, respectively.[24] Furthermore, the

Table 4 Multivariable Analysis of Selected Anthropometric and Lifestyle Variables, While Controlling for Education Level, Family Income, and Father's and Mother's Education Levels, Among Saudi Females Relative to Age Group Category (Data are Means and Standard Deviations)

Variables	Younger Age Group (60.7%)	Older Age Group (39.3%)	*p*-value *
Age (years)	23.9 ± 3.3	36.9 ± 6.4	< 0.001
Weight (kg)	66.7 ± 14.1	73.5 ± 15.3	< 0.001
Height (cm)	158.5 ± 5.3	158.7 ± 5.8	0.375
BMI	26.5 ± 5.4	29.2 ± 5.6	< 0.001
Screen time (hours/day)	4.8 ± 2.4	3.8 ± 1.6	< 0.001
Sleep duration (hours/night)	6.9 ± 1.6	6.4 ± 1.4	0.013
Sum of activity energy expenditure from moderate intensity physical activity (METs-min/week)	1441.0 ± 1249.1	1668.4 ± 1454.3	0.242
Sum of activity energy expenditure from vigorous intensity physical activity (METs-min/week)	2378.5 ± 2267.9	2022.5 ± 1869.6	0.105
Total activity energy expenditure from all physical activity (METs-min/week)	3819.5 ± 2707.4	3690.9 ± 2672.9	0.479
Breakfast intake (day/week)	4.4 ± 2.7	4.9 ± 2.6	0.094
Vegetable intake (day/week)	4.4 ± 2.2	5.2 ± 1.9	< 0.001
Fruit intake (day/week)	3.6 ± 2.3	4.0 ± 2.2	0.067
Milk & dairy products intake (day/week)	4.6 ± 2.4	4.7 ± 2.3	0.327
Sugar-sweetened drinks intake (day/week)	1.7 ± 1.9	1.2 ± 1.8	0.023
Fast foods intake (day/week)	1.9 ± 1.5	1.2 ± 1.1	< 0.001
French fries/potato chips intake (day/week)	1.6 ± 1.5	0.90 ± 0.98	< 0.001
Cake/donuts intake (day/week)	1.9 ± 1.8	2.0 ± 1.9	0.772
Chocolates/candy intake (day/week)	2.7 ± 2.2	2.9 ± 2.4	0.352
Energy drink intake (day/week)	0.22 ± 0.75	0.01 ± 0.12	0.001
Weight loss attempts	2.2 ± 0.78	2.4 ± 0.76	0.014

Note: * Wilks' Lambda F = 35.409, p = < 0.001; p-values for tests of between-subjects effects are presented in the table.
Abbreviation: METs-min/week, metabolic equivalent in minutes per week.

reported prevalence of overweight and obesity among women sampled from the community in Jeddah was 30.1% and 35.6%, respectively.[26] Also, a cross-sectional survey,[27] conducted in selected primary health-care centers in Riyadh city with a higher mean age than that in the present study (43.8 ± 10.9 versus 29.2 ± 8.2 years), reported a higher mean BMI value than the one found in the present study (31.4 ± 6.5 compared to 27.5 ± 5.4 kg/m^2). However, the somewhat lower rate of overweight or obesity among this sample of females compared to those in previously mentioned studies may be explained by the fact that the majority of Saudi women enrolling in fitness centers were seeking weight loss and were fairly active. In addition, although overweight or obesity prevalence among the young females (younger than 30 years) in the current study appears much lower than the overweight or obesity rate of those 30 years of age or older (53.3% versus 76.4%), this prevalence rate for the younger age group is still much higher than those reported for college-age women reported in previous studies, which ranged from 28.1% to 29.5%.[28,29] However, we have to recall that the majority of these females reported in the present study were enrolled in fitness centers with the main goal to lose weight.

Table 5 The Proportion (%) of Inactive and Active Participants Relative to Overweight or Obesity Status

Variables	Non-Overweight/ Non-Obesity	Overweight/ Obesity	*p*-value *
Inactive (<600 METs-min/week)	5.4%	6.9%	0.329
Active (≥600 METs-min/week)	94.6%	93.1%	

Note: *Chi-square test.
Abbreviation: METs-min/week, metabolic equivalent in minutes per week.

The present study revealed that females who were overweight or obese were significantly older, married, have more children, have a lower educational degree, earn less income, have higher numbers of obesity in the family, and have had more frequent attempts to lose weight compared with non-overweight or non-obese participants. Findings from the last national survey, conducted in the year 2013, indicated that the risk of obesity

Table 6 Results of Multiple Linear Regression Analyses for the Prediction of Body Mass Index from the Lifestyle and Socio-Demographic Factors

Dependent Variables	Predictor Variables	Standardized Coefficient (Beta)	p-value	R	Adjusted R^2
Body mass index					
Model 1	Weight-loss attempts	0.363	< 0.001	0.363	0.129
Model 2	Weight-loss attempts Age	0.341 0.238	< 0.001 < 0.001	0.433	0.183
Model 3	Weight-loss attempts Age Number of obesity in the family	0.307 0.250 0.167	< 0.001 < 0.001 < 0.001	0.463	0.208
Model 4	Weight-loss attempts Age Number of obesity in the family Education level	0.301 0.251 0.163 − 0.142	< 0.001 < 0.001 0.001 0.002	0.485	0.226

among women increased with age, being married or previously married, compared with those never married.[13] Also, the national survey found that women who had more education than high school were less likely to be obese than those who had a primary school education level or less. Further, lifestyle habits such as diet indicators or physical activity were not significantly associated with obesity among Saudi women, as vegetable and fruit consumption was similar among obese and non-obese Saudis, and over 75% of women had low to no physical activity at all.[13] In another study, higher body mass index and physical inactivity among Saudi women were shown to be associated with poor self-rated health, and have implications for public health policies and interventions aimed at improving the health and quality of life for such women.[30] It is interesting to indicate that another study, which intended to gain a better understanding of the healthy lifestyle consumer by investigating demographic, personal values, and psychographic antecedents using cluster analysis, showed that people who maintain a healthy lifestyle tend to be female, older, more educated, put less importance on the value of "excitement," have a greater tendency to plan ahead, and tend to experience less role overload.[31]

Lifestyle habits have been linked to obesity in numerous studies.[10,11,32] In addition, it is well recognized that cultural values and beliefs as well as socio-economic factors and the built environment can greatly influence lifestyle behaviors. Physical inactivity and low intake of fruits and vegetables, for example, are considered among the major yet preventable risk factors for NCDs.[33] Compared with standard care, lifestyle interventions were reported to be effective in reducing several obesity indices, such as bodyweight, body mass index, waist circumference, as well as numerous cardiovascular risks like blood pressure, blood lipids and blood glucose in overweight and obese people, with favorable effects maintained up to three years.[32] Moreover, findings from the prospective Danish Diet study showed that adherence to healthy lifestyle behaviors was linked to a lower risk of acute coronary syndrome even among obese individuals.[34]

The results from the present study did not find significant differences in the total activity energy expenditure from all physical activity (METs-min/week) between overweight/obese compared with non-overweight/non-obese or between younger compared with older age groups. The physical activity instrument used in the present study collects activity data from all domains of physical activities, including household, transport, fitness, and recreational sports activities. The American College of Sports Medicine recommended moderate physical activity above 250 minutes per week for long-term weight loss.[35] Further, a randomized controlled trial, involving overweight and obese women (age = 18–40 years; BMI = 27–37 kg/m^2) undergoing a weight-loss program, showed that weekly physical activity of longer duration conducted over fewer sessions during the week could be more effective for weight loss than those activity sessions undertaken with more frequent and shorter duration.[36] This may be helpful for those who are neither willing nor able to schedule time

for physical activity sessions almost every day to achieve weight loss. However, due to the cross-sectional nature of our study, we did not examine the differences in exercise frequency and duration of weekly sessions over time.

The current findings did not find significant differences between overweight/obese compared with non-overweight /non-obese females in many selected lifestyle variables, including activity energy expenditure, screen time, and sleep duration. Similar findings were found in a previous study involving female college students.[29] However, the participants in the current study were much more active than those reported for young college females (94% versus 49.6% were expending 600 METs-minutes or more per week).[29] Our findings about the lack of association between obesity and physical activity may be explained by the fact that most of the females in the sample were fairly active. The high prevalence of high levels of activity in the present sample made the participants homogenous in terms of physical activity, which may have reduced the relationship between physical activity and overweight or obesity status. A similar finding was found between physical inactivity and obesity levels among women in a national survey; however, this was attributed to the low activity level among a large percentage of Saudi females.[13] In line with our findings, the relationships between lifestyle behaviors and overweight or obesity among Saudi females attending health science colleges were previously investigated; however, the finding did not show significant associations between lifestyle habits of college females and overweight or obesity status.[29] In contrast, a previously published study involving a large number of Saudi youth showed that a number of lifestyle behaviors exhibited significant gender effects, with some particular variables showing multiple interaction effects between gender, obesity, and lifestyle behaviors.[37] Obesity and insufficient physical activity, though, were reported to be significant predictors of multiple morbidities among people aged 55–70 in New Zealand.[38]

In the present study, the weight-loss attempts, age, number of obesity in the family, and females' education level emerged as the most important contributory factors to obesity status, explaining about 23% of the common variances. Among Saudi college-aged students, a significant moderate relationship (r = 0.370) between BMI and weight-loss attempts was reported.[28] Weight-loss attempts, thus, appear to be a critical variable to consider when developing interventions for weight loss. A recent large cross-sectional study indicated an increasing trend in the proportion of participants who attempted to lose weight among adults in the USA.[39] However, data from the National Health and Nutrition Examination Survey over a 10-year period from 2005 to 2014 showed that unhealthy weight-loss strategies are associated with increased odds of depression.[40]

The present study has its strengths and limitations. Among the strengths of the current research is having a representative sample of Saudi women from all fitness centers in the city of Riyadh. In addition, we have used a reliable and valid lifestyle questionnaire that covers physical activity, sedentary behaviors, sleep, and dietary habits. It employs metabolic equivalents for calculating energy expenditure from all domains of physical activity and not just fitness and recreational activities. Also, the weight and height values included in this study were actually measured and not reported by the participants. However, we also acknowledge some limitations for the present study. First, the cross-sectional nature of this study does not allow us to assume causal relationships between overweight or obesity and the lifestyle or socio-demographic factors. Second, due to the nature of the questionnaires, in general, we cannot exclude the potential for recall bias in reporting all the lifestyle behaviors. Third, the study findings may not be generalized to all Saudi females, as the sample in the present study came from females who are already participating regularly in fitness centers, and therefore may have stronger motives to lose weight compared with the general population. Fourth, the current sample has also more overweight or obesity prevalence than the general population, based on comparison with a national survey. Fifth, the part in the questionnaire related to food frequency items did not account for portion size, something that may have impacted the relationships between dietary habits and overweight or obesity status.

Conclusion

The present study examined the associations of overweight or obesity with several lifestyle and socio-demographic factors among Saudi women attending fitness centers in Riyadh. The main findings of this study indicated that the majority of the participants were overweight or obese seeking weight loss, yet they were highly active in terms of total activity energy expenditure. The findings also showed that females who were overweight or obese are significantly older, married, have more children, have a lower educational degree, earn less income, have higher numbers of obesity in the family, and had attempted to

lose weight more frequently than those females who were not overweight or obese. In addition, there was no significant difference in activity levels between overweight or obesity versus non-overweight non-obesity status. Only a few lifestyle behaviors are significantly different relative to overweight or obesity status, namely intake of milk and dairy products and fast foods. The older age group showed significantly higher values of bodyweight, BMI, vegetable intake, and number of attempts to lose weight, whereas the younger age group exhibited higher values of screen time, sleep duration, and intake of sugar-sweetened drinks, fast foods, French fries and potato chips, and energy drinks. Multiple linear regression analysis for the prediction of body mass index from the lifestyle, anthropometric, and demographic factors showed that weight-loss attempts, age, number of obese members in the family, and female's education level were the most important contributory factors to overweight or obesity status, explaining nearly 23% of the common variances. Primary prevention of overweight and obesity by promoting healthy lifestyle behaviors should still be a major public health goal. A better understanding of the relationships between obesity and lifestyle behaviors is necessary for effective prevention and management of obesity in females and can assist in planning effective interventions targeting Saudi females.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article. Any additional data will be available from the corresponding author upon reasonable request.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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