OBESITY CORRELATES/INTERVENTIONS

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Overweight and obesity among adults in the Gulf States: A systematic literature review of correlates of weight, weight-related behaviours, and interventions

Abdulaziz Balhareth[1,2] (iD) | Ree Meertens[1,3] | Stef Kremers[1] | Ester Sleddens[1]

[1] Department of Health Promotion, NUTRIM School of Nutrition and Translational Research in Metabolism, Maastricht University Medical Center+, Maastricht, The Netherlands

[2] Department of Health Education and Promotion, Faculty of Public Health and Tropical Medicine, Jazan University, Jazan, Saudi Arabia

[3] Department of Health Promotion, CAPHRI Care and Public Health Research Institute, Maastricht University Medical Center+, Maastricht, The Netherlands

Correspondence
Abdulaziz Balhareth, Department of Health Promotion, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands.
Email: a.balhareth@maastrichtuniversity.nl

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Summary

Obesity has increased to an epidemic level in the Gulf States. This systematic review is the first to explore the scientific evidence on correlates and interventions for overweight (body mass index [BMI] $\geq$ 25) or weight-related behaviours in the region. A systematic search of peer-reviewed articles was conducted using PubMed and PsycINFO. Ninety-one studies were eligible for this review including 84 correlate studies and seven intervention studies. Correlate studies of overweight focused on sociodemographic factors, physical activity, and dietary habits. Low physical activity, sedentary behaviour, and unhealthy dietary habits were associated with overweight. The most-reported sociodemographic correlates of overweight were increased age, being married, low education, urban residence, and unemployment. Correlate studies of physical activity and dietary behaviours mostly focused on sociodemographic variables. Being female and increased age (the latter less consistently) were associated with low physical activity. Interventions were very heterogeneous with respect to the target group, intensity, and behavioural strategies used. The effectiveness of interventions was difficult to evaluate because of the chosen study design or outcome measure, the small sample size, or high attrition rate. Few studies have investigated sociocognitive and environmental determinants of weight-related behaviours. Such information is crucial to developing health promotion initiatives that target those weight-related behaviours.

KEYWORDS

adults, correlate studies, intervention studies, Middle East, overweight/obesity

1 | INTRODUCTION

Levels of overweight (body mass index [BMI] $\geq$ 25) and obesity (BMI $\geq$ 30) have been increasing significantly during the last four decades. This increase has been particularly dramatic in the Gulf States, including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.[1] In the past, Arabs associated overweight/obesity with wealth and prosperity for men and with health and fertility for women.[1] However, these views are changing, and obesity is currently perceived as a very serious health issue and risk factor for many comorbidities.[2] The estimated prevalence of overweight among adults in Saudi Arabia has increased from 38.1% in 1975 to 69.7% in 2016.[3] In Saudi Arabia, 20 000 people die each year from diseases associated with overweight and obesity.[4] The Saudi

Abbreviations: BMI, body mass index; FV, fruit and vegetable; PA, physical activity; WC, waist circumference

government is spending over 19 billion riyals (€4.5 billion) annually to fight the burden of these diseases.[4] The prevalence and associated health care costs of obesity are similar to other Gulf States.[3] Fortunately, overweight and obesity are among the most preventable causes of morbidity and mortality.[5] Therefore, these costs and negative health effects can be reduced if more investments are made in effective prevention strategies. To develop effective behavioural interventions, it is essential to examine the potential determinants of obesity or weight-related behaviours and to review existing interventions targeting these weight-related behaviours.

There have been several systematic reviews and "umbrella reviews" (reviews that give an overview of the systematic reviews conducted in an area) on correlates of overweight/obesity, including reviews on (correlates of) dietary behaviours, physical activity (PA), and sedentary lifestyle.[6-9] Moreover, there are some systematic reviews of interventions on diet and PA for the prevention of obesity in adults.[10,11] However, these reviews were directed at, and/or mainly covered, studies in the United States, Australia, or Europe. Although there are some systematic reviews on the prevalence of overweight and obesity in the Gulf States,[12,13] to our knowledge, reviews on correlates and interventions in that region do not exist. This knowledge gap is especially worrisome because the correlates and active ingredients of interventions in the Gulf States may differ considerably from those in Western countries. Such a review would increase our knowledge of the most important contributing factors to, and determinants of, overweight/obesity and weight-related behaviours in the Gulf States. This knowledge would help health professionals and policymakers to develop environmental and/or behavioural modification strategies and effective interventions. The purpose of this study is to perform a systematic literature review of the correlates of overweight/obesity and weight-related behaviours in the Gulf States and of interventions for overweight/obesity among adults in this region.

2 | METHODS

2.1 | Search strategy and eligibility criteria

A comprehensive, systematic search of peer-reviewed articles published up until 12 September 2017 was conducted using the databases PubMed and PsycINFO. The search strategy involved a combination of MeSH terms in PubMed, thesaurus terms in PsycINFO, and title and abstract for all terms (see Table S1 for the search strategy in PubMed).

To be included, studies had to be conducted in the Gulf States. Studies on correlates of overweight and/or obesity were included, as were studies of correlates of PA, dietary behaviours, and sedentary lifestyle (eg, screen viewing). Second, we included evaluation studies of either overweight or obesity interventions and related interventions such as diet or PA interventions. Studies about nutrients such as protein and fat were not included. We also excluded studies that focused on a specific population (eg, patients with any chronic disease or pregnant women), studies that were not empirical, qualitative and case studies, studies involving treatments such as drugs or surgery, and studies not published in peer-reviewed scientific journals. The current review focuses on adults (18 y or more). A second review, conducted using the same methodology, on

the correlates of dietary behaviour, PA, and overweight/obesity in children and adolescents will be published elsewhere.

A total of 3489 studies (3253 in PubMed and 236 in PsycINFO) were found, which ultimately resulted in 91 articles eligible for data extraction (see Figure 1 for the procedure of the literature search, and see Tables 1–4 for the data extraction forms developed by the authors).

3 | RESULTS

First, the results of the 84 eligible correlate studies[14-95] are described, followed by the data on the seven intervention studies.[96-102]

3.1 | Correlate studies

All correlate studies were cross-sectional,[15-95] except for one longitudinal study.[14] Half of the studies were performed in Saudi Arabia,[15-44,73-76,78,81-86,90,91] and a large number were performed in Kuwait.[45-57,77,80,92,95] Approximately 30% of studies involved university students. Most correlate studies were conducted in both urban and rural areas; a few studies were conducted on urban populations only, while no study was based on rural populations only. More than 60 studies included both genders, while 25 included women only and eight included men only.

In order to present the findings of the correlate studies in a structured way, we grouped them into three categories (1) studies on correlates of overweight/obesity, (2) studies on behavioural correlates of PA and sedentary behaviour, and (3) studies on behavioural correlates of dietary behaviours.
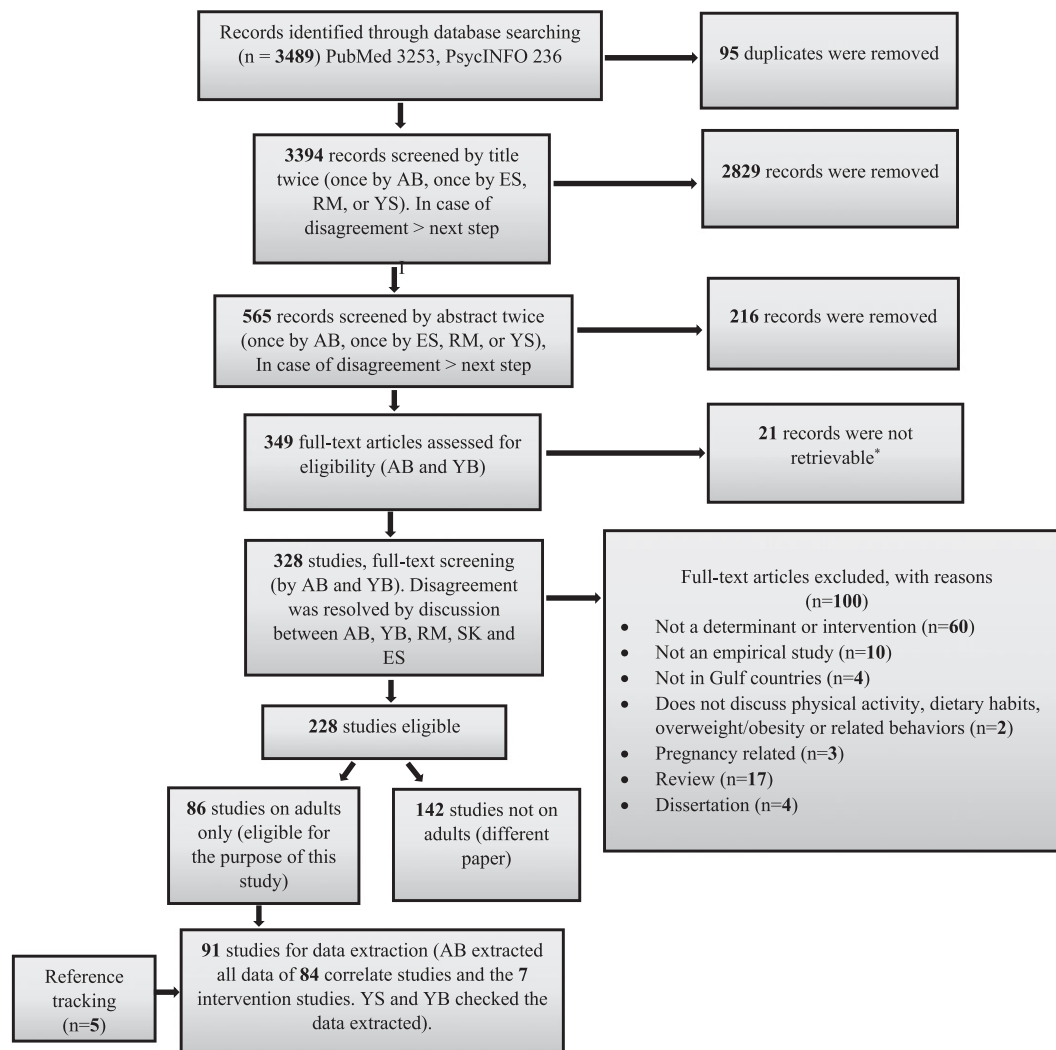
3.1.1 | Correlates of overweight/obesity

There were 69 studies of correlates of overweight/obesity (see Table 1 for details). Most studies investigated only sociodemographic factors as correlates of overweight/obesity, while a substantial number looked at dietary behaviours, PA, and sedentary behaviour as correlates of overweight/obesity. Some studies associated sleep duration, sleep disturbance, media, and body image with overweight/obesity. The results of Table 1 are discussed under the following headings: (a) PA and sedentary behaviour, (b) dietary behaviours (consumption behaviours), (c) sociodemographic factors (such as gender, age, education, and marital status), and (d) miscellaneous (such as sleeping behaviour, smoking, and family history of obesity). Many studies addressed correlates of more categories (eg, PA as well as sociodemographic factors).

PA and sedentary behaviour
The results indicated that people who were physically active showed lower levels of BMI and waist circumference (WC) than people who were less physically active.[15,16,18-23,25,30,36,37,47-49,52,54,57,60,79] Two studies found no significant association between PA and obesity.[14,44] Personal barriers to PA, such as lack of interests, skills, and motivation, were experienced more by men with obesity than by others.[51] Women with obesity felt more embarrassed when exercising outdoors than women who were non-obese.[51] Many studies showed that increased sedentary and physical inactivity behaviours were

FIGURE 1 Flow diagram of literature search

Flow diagram contents:

- Records identified through database searching (n = **3489**) PubMed 3253, PsycINFO 236
- **95** duplicates were removed
- **3394** records screened by title twice (once by AB, once by ES, RM, or YS). In case of disagreement > next step
- **2829** records were removed
- **565** records screened by abstract twice (once by AB, once by ES, RM, or YS), In case of disagreement > next step
- **216** records were removed
- **349** full-text articles assessed for eligibility (AB and YB)
- **21** records were not retrievable*
- **328** studies, full-text screening (by AB and YB). Disagreement was resolved by discussion between AB, YB, RM, SK and ES
- Full-text articles excluded, with reasons (n=**100**)
  - Not a determinant or intervention (n=**60**)
  - Not an empirical study (n=**10**)
  - Not in Gulf countries (n=**4**)
  - Does not discuss physical activity, dietary habits, overweight/obesity or related behaviors (n=**2**)
  - Pregnancy related (n=**3**)
  - Review (n=**17**)
  - Dissertation (n=**4**)
- **228** studies eligible
- **86** studies on adults only (eligible for the purpose of this study)
- **142** studies not on adults (different paper)
- **91** studies for data extraction (AB extracted all data of **84** correlate studies and the **7** intervention studies. YS and YB checked the data extracted).
- Reference tracking (n=**5**)

* Full texts of these articles were not found after searching in the Maastricht University library, in other Dutch university libraries, via an international system of collaborating university libraries and mailing the first authors.

associated with high BMI.[19,22,23,26,36,45,48,49,57,59,60,64] Transport inactivity among men and sitting time among women were associated with high BMI.[64] With the exception of one study,[61] the findings showed quite consistently that all types of inactivity were correlates of overweight/obesity.

Dietary behaviour

The findings suggested that there was an association between unhealthy dietary habits and overweight/obesity. A positive correlation was observed between caloric intake and BMI levels.[19,22,23] Low consumption of fruit and vegetable (FV), fibre, grains, and beans; high consumption of fat; high fast food intake; high soft drinks consumption; eating with friends; or eating out were the main eating behaviours that were associated with obesity.[20,29,30,36,37,54] However, in one study, vegetable consumption was higher among participants with obesity[49] compared with their normal-weight counterparts. The associations between skipping meals and obesity were not consistent.[27,58,67] Findings related to frequent unhealthy snacking and obesity were inconsistent as well.[31,58,79] The tradition of food

hospitality and other behaviours related to eating, such as eating due to emotional states of stress, anger, and boredom, were correlated with female obesity.[22] Lack of basic nutritional knowledge about healthy food and energy-dense food was one of the main factors associated with overweight/obesity.[59] People who ate breakfast at home had significantly higher BMI levels compared with those who skipped breakfast at home.[27,49]

Sociodemographic factors

Fifty-two studies investigated the association between sociodemographic factors and overweight/obesity among adults. Most studies showed that increased age was significantly associated with overweight/obesity but that weight seemed to drop again after the age of 50 or 60.[50,68,72,74,75] While some studies showed that women had a significantly higher prevalence of overweight/obesity compared with men,[21,32,35,52,55,62,68,75,76,78] others showed the opposite.[19,29,36,39,41,42,44,53,59,70,73] Most studies showed that obesity was higher among married adults.[20,21,30,40,50,56,67-69] While some studies revealed that low income was associated with a high

TABLE 1 Descriptive summary of correlate studies of overweight and obesity

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
Sayegh et al (2016)[14]	Qatar	-	18-64, 37.4 (11.7)	549	Qatari females	Physical activity	Obesity "BMI"	Self-administered survey	There was no statistically significant difference among BMI levels with respect to **physical activity.**
Bin Horaib et al (2013)[15]	Saudi Arabia	Urban + rural	34.12 (7.25)	10 229	Military male personnel	Sociodemographic factors, smoking, dietary habits, and physical activity	Overweight and obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Increased age, more years of education, and **family history of *diabetes or hypertension*** were related to higher BMI, while **higher *military rank, smoking, eating fruits more than twice per week,* and strenuous physical activity** were related to lower BMI.
Al-Nozha et al (2007)[16]	Saudi Arabia	Urban + rural	30-70, 46.3 (11.50)	17 395	Saudis (8297 males and 9098 females)	Physical activity	BMI and waist circumference (WC)	National Epidemiological Health Survey by researcher	Individuals who were **physically active** showed lower values of BMI and WC.
Al-Nozha et al (2005)[17]	Saudi Arabia	Urban + rural	30-70	17 232	Saudis (8215 males and 9008 females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey	Overweight was higher among males, while obesity was higher among females. Urban residents were more obese compared with Saudis living in rural areas. Obesity is the highest among Saudis living in the eastern region of Saudi Arabia, while the lowest rate was observed in the southern region. Regarding age group, 40-49 were most obese, and 60-70 were most overweight.
AlAteeq and AlArawi (2014)[18]	Saudi Arabia	Urban	39.2 (8.91)	322	Clinicians (127 males and 195 females)	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey	Females had lower BMI than males. No significant correlation was found between *dietary habits* and BMI. **Higher levels of physical activity** were associated with lower BMI. Nurses and pharmacists had a significantly lower BMI compared with physicians.
Allam et al (2012)[19]	Saudi Arabia	Urban + rural	21.06 (1.85)	194	University medical students (94 males and 100 females)	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Male students showed higher rates of obesity than females. A positive correlation was observed between *the median caloric intake and BMI.* **Inactivity** was associated with *increased median caloric intake and BMI. High intakes of carbohydrates and animal foods and low intakes of fibre, minerals, and vitamins coupled* with **low physical activity** were associated with overweight and obesity among students.
Al Qauhiz (2010)[20]	Saudi Arabia	Urban + rural	22-24, 20.78 (3.01)	799	Female university students	Sociodemographic factors and dietary habits	Obesity "BMI"	Self-administered survey	Being married, **presence of obesity *among family members,*** and

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									frequency of soft drinks consumption were related to obesity.
Al-Baghli et al (2008)[21]	Saudi Arabia	Urban + rural	30 and older	195 874	Saudis (99 946 males and 95 905 females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey	The highest prevalence of obesity was detected in the age group 50-59 y. Obesity increased with age. It was higher among women than men, higher in housewives, higher among married subjects, higher among the less well educated, those with low income, and **those who were less physically active.**
Rasheed (1998)[22]	Saudi Arabia	Urban	29.28 (7.70)	144	Saudi females	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	*High consumption of calorie-rich diets, the traditional system of food hospitality,* **low physical activity, lack of awareness regarding obesity status,** *and attitudes and behaviours related to eating (antecedents of eating such as emotional states of stress, anger, and boredom) were the main risk factors for female obesity. Obese participants were less likely to eat at fixed times during the day and more often indulged in eating while* **watching TV.**
Almajwal (2015)[23]	Saudi Arabia	Urban + rural	18 and older	362	Non-Saudi female nurses	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	**Low physical activity** was related to high BMI. Nurses who worked shift duty had significantly higher BMIs compared with day shift nurses. Nurses who rarely ate breakfast and meals and often ate fast food were more likely to be overweight or obese.
Almajwal (2016)[24]	Saudi Arabia	Urban	18 and older	395	Non-Saudi female nurses	Dietary habits, emotion, and stress	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	BMI was significantly correlated with *restrained eating style (the tendency to restrict food intake in order to control body weight), emotional eating style (the tendency to cope with negative emotions),* **and stress.**
Khalaf et al (2013)[25]	Saudi Arabia	Urban + rural	20.4 (1.50)	663	Female university students	Physical activity	Obesity "BMI"	Self-administered survey	**High physical activity** was related to high BMI.
Samara et al (2015)[26]	Saudi Arabia	Urban	18-22, 20 (0.70)	94	Female university students	Sedentary behaviour	Obesity "BMI"	Self-administered survey	**High sedentary behaviour** was associated with high BMI.
El Hamid (2014)[27]	Saudi Arabia	Urban + rural	18-28, 20.78 (1.76)	400	Female university students	Home breakfast skipping	Obesity "BMI"	Self-administered survey	*Home breakfast eaters had a significantly higher BMI compared with home breakfast skippers.*
	Saudi Arabia	Urban + rural	20-56	242			Obesity "BMI"		

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
Al-Otaibi (2013)[28]	Saudi Arabia	Urban + rural			Saudis (118 males and 124 females)	Sociodemographic factors		Self-administered survey + anthropometric measurements by researcher	Males had higher BMI levels than females.
Al-Otaibi (2013)[29]	Saudi Arabia	Urban + rural	21.74 (1.55)	960	Female university students	Fruit and vegetable consumption	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	*Females who consumed less than five servings per day group had higher BMI than the five or more servings per day group.*
Khalaf et al (2014)[30]	Saudi Arabia	Urban + rural	18 and older, 20.4 (1.50)	663	Female university students	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey	Social factors positively associated with high BMI were **the presence of obese parents and siblings**, being married, **high number of sisters**, high level of father's education, more frequent intake of French fries/potato chips (greater than three times per week), and **low physical activity levels.**
Al-Rethaia et al (2010)[31]	Saudi Arabia	Urban + rural	18-24	357	Male university students	Dietary habits	Obesity "BMI" "VFL"	Self-administered survey	*Eating with family and frequent snacking were found to be related to high BMI. Visceral fat level (VFL) was inversely correlated with the frequency of both eating with family and date consumption.*
Al-Nuaim et al (1997)[32]	Saudi Arabia	Urban + rural	20 and older, 35.8 (14.27)	10 651	Saudis (50.8% males and 49.2% females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	The prevalence of obesity was higher in females than males, lower in subjects living in rural areas with traditional lifestyles than those in more urbanized environments, and increased with increased age, lower education, and income.
Khalid (2007)[33]	Saudi Arabia	Urban + rural	18-60	438	Married, nonpregnant females	Sociodemographic factors and physical activity	Obesity "BMI" and abdominal obesity	Self-administered survey + anthropometric measurements by researcher	Increased age, total obesity, and **multiple pregnancies** were significantly associated with a higher prevalence of **abdominal obesity**. Low educational level and **low physical activity** were associated with higher abdominal obesity.
Al Dokhi and Habib (2013)[34]	Saudi Arabia	Urban + rural	18-72, 36.91 (15.22)	411	Saudis (300 males and 111 females)	Sociodemographic factors "gender"	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Males had a significantly higher prevalence of overweight compared with females. Females had a significantly higher prevalence of class II and III obesity compared with males.
Al-Shahrani Al-Khaldi (2011)[35]	Saudi Arabia	Urban + rural	36.2 (13.60)	429	Patients attended health care clinics (217	Sociodemographic factors "gender," dietary habits, and physical activity	Obesity "BMI"	Records of people attending health promotion clinics by researcher	Obesity was higher among women than men and among those above 45 y old.

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
					males and 212 females)				
Abdel-Megeid et al (2011)[36]	Saudi Arabia	Urban + rural	21.1 (2.80)	312	University students (132 males and 180 females)	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Males had a higher percentage of overweight and obesity when compared with females. Increased fat consumption was correlated with high BMI. High economic status was correlated with high BMI. *Low consumption of fibre, grains, vegetables, fruits, and beans* and **low exercise level** of both genders were correlated with high BMI.
Aboul Azm (2010)[37]	Saudi Arabia	Urban + rural	18-22, 20.17 (1.30)	300	Saudi female nursing students	Dietary habits and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	*More obese students were taking meals irregularly, snacking more frequently, and drinking more beverages and coffee/tea as* compared with non-obese students. *Not having breakfast in the morning and rarely eating green, red, or yellow coloured vegetables, eating fried food, eating fast food, eating with friends, and eating out were practices associated with* obesity. In addition, obese students had a **lower physical activity level.**
Al-Shammari et al (1994)[38]	Saudi Arabia	Urban + rural	32.2 (11.70)	1385	Saudi females	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Poorly educated housewives more than 45 y old, particularly divorced, or widowed ones had higher BMI than others. BMI increased with age and **multiple pregnancies.** Participants living in rural areas had higher BMIs than those living in urban areas.
Albarrak et al (2016)[39]	Saudi Arabia	Urban	18 and older	448	University students (177 males and 271 females)	Sociodemographic factors "gender"	Overweight and obesity "BMI"	Self-administered survey	Prevalence of overweight and obesity was higher among male compared with female students.
Albawardi et al (2016)[40]	Saudi Arabia	Urban	18-58	420	Saudi females working in office jobs	Sociodemographic and psychosocial factors	Overweight and obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	Overweight/obesity was associated with increased age (over 35 y old), being married, **having at least one child,** having an education level above high school, having a family income of less than 10 000 Saudi riyals (SR), and working in the public sector (as compared with private sector). **Physical activity, social support, and general self-efficacy** were not found to be

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									associated with being overweight or obese.
Alodhayani et al (2017)[41]	Saudi Arabia	Urban + rural	18-25, 20.7 (2.33)	408	University medical students (224 males and 184 females)	Sociodemographic factors, sleep disturbances, and sleep duration	Overweight and obesity "BMI"	Self-administered survey + anthropometric measurements were taken	Male subjects had higher BMI than females. Normal-weight subjects had a higher-frequency percentage who reported in losing weight (30.6%) by **performing exercise** (25.7%) and *diet* (27%) on a regular basis compared with overweight and obese subjects. Also, results showed that there was an association between *lack of sleep* and reported weight gain, which can lead to obesity. The *duration of sleeping between 5 and 6 h* was linked to weight gain. There was a correlation between obesity and *disturbance of sleep*. Overweight and obese subjects had *higher sleep disturbances* such as watching television, lying down after lunch, and sitting and reading than normal-weight subjects.
Azzeh et al (2017)[42]	Saudi Arabia	Urban	18-60, 29.1 (8.5)	2548	Saudis (188 males and 224 females)	Sociodemographic factors	BMI, WC, total body fat, and visceral fat level (VFL)	Self-administered survey + anthropometric measurements by trained staff	The prevalence of obesity and overweight was higher in men than in women. Waist circumference and visceral fat level were higher in men than in women, but the mean total body fat percentage was higher in females than in males.
Al-Tannir et al (2016)[43]	Saudi Arabia	Urban + rural	18 and older, 33.3 (11.8)	1369	Saudi citizens	Sleep disturbances	Overweight and obesity "BMI"	Self-administered survey	Obesity was significantly associated with *sleep disturbances*. High levels of BMI were related to *short sleep duration*.
Saeed et al (2017)[44]	Saudi Arabia	Urban + rural	18-24, 21.2 (1.2)	292	University students (146 males and 146 females)	Sociodemographic factors + physical activity	Overweight and obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	Males had a higher prevalence of obesity than females. *Subjects with chronic diseases* were more prone to be obese. *Family history of obesity* was significantly associated with obesity. No significant association was found between physical activity and obesity.
Allafi and Waslien (2014)[45]	Kuwait	Urban + rural	18-59, 26 (7.90)	1370	Kuwaiti males and females	Physical activity "inactivity"	Overweight and obesity "BMI"	Self-administered survey	**High physical inactivity** patterns were associated with high levels of BMI.
Al Zenki et al (2012)[46]	Kuwait	Urban + rural	20-86, M 39.1 (0.90) and F 40.9 (0.70)	1830	Kuwaiti adults (459 males and 533 females)	Sociodemographic factors "gender"	Overweight and obesity "WC and BMI"	Self-administered survey + anthropometric measurements by researcher	Waist circumferences (WC) of males were significantly higher than those of females; however, the BMI and body fat levels of females were

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									significantly higher than those of males. Males had a higher percentage of overweight than females; however, a significantly higher percentage of females were obese compared with males.
Al-Isa (2004)[47]	Kuwait	Urban	20 and older	461	Female teachers	Sociodemographic factors, physical activity, obesity history, and dental status	Overweight and obesity "BMI"	Self-administered survey	Factors found to be significantly associated with overweight, and obesity included increased age, being married, *parents living at home, parental obesity, high number of obese relatives, low exercise, and low dental status.*
Al-Isa (2011)[48]	Kuwait	Urban + rural	18 and older	787	Kuwaiti university students (378 males and 409 females)	Sociodemographic factors and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Obesity was higher among males than females, 13% to 10.5%, respectively. High levels of BMI were associated with **low physical activity.**
Ramadan and Barac-Nieto (2001)[49]	Kuwait	Urban	18-37, 28.32 (1.83)	45	Male office workers or students	Physical activity, fitness level, and body composition	Obesity "BMI, skin folds, body fat content, and fat percentage"	Self-administered survey + anthropometric measurements by researcher	**Sedentary and minimally physically active** groups had higher body weight, BMI, skin folds, body fat content, and fat percentage.
Badr et al (2013)[50]	Kuwait	Urban + rural	50 and older, 64.3 (9.30)	2443	Elderlies (948 males and 1495 females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	In general, higher age was related to more overweight and obesity. However, Kuwaitis aged 50-59 were 1.7 and 2.2 times more likely to be overweight and obese, respectively, compared with those aged 70 or older. Married individuals had 2.3 times higher risk of being overweight or obese than nonmarried individuals. Women were 3.6 times more likely to suffer from obesity than were men.
Musaiger et al (2014)[51]	Kuwait	Urban + rural	19-26, 21 (3)	530	University students (203 males and 327 females)	Sociodemographic factors, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey	Students with obesity were *more likely to face barriers to healthy eating than other students.* Also, males with obesity faced more significant **personal barriers to physical activity than other males, such as lack of interest in being physically active, skills, and motivation to exercise.** There were no significant differences between women with obesity and women who are not obese regarding barriers to *healthy eating* and **physical activity.**
Al-Isa (1999)[52]	Kuwait	Urban + rural	18 and older	515		Sociodemographic factors, dental	Obesity "BMI"	Self-administered survey + anthropometric	Increased age, *poor dental status, having a chronic disease, high*

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
					Kuwaiti male college students	status, obesity history dietary habits, and physical activity		measurements by researcher	***number of obese brothers, high number of obese relatives, high parental obesity***, low educational level, ***low grade point average (GPA), low high school GPA, high number of persons living at home***, low monthly family income, ***low physical activity, low practice of sports, number of children, poor health status***, dieting, number of ***times dieted, feeling tired***, and ***needing special nutritional*** programmes were the factors found to be associated with overweight and obesity.
Al-Asi (2003)[53]	Kuwait	Urban + rural	18 and older	3282	Kuwait oil company employees (2804 males and 478 females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Males showed a higher level of overweight and obesity (79%) than females (56%). Field workers had a higher level of overweight and obesity (78%) than office workers (72%).
Al-Kandari (2006)[54]	Kuwait	Urban + rural	21-77	424	Kuwaitis (212 males and 212 females)	Sociodemographic factors, sociocultural characteristics, dietary habits, and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Findings showed that there was a negative association between BMI and **general physical activity and physical activity at work**. Also, there was a positive association between BMI and some social variables, including ***number of relatives living in the same household and number of families living in the same household***, while no relationship was found with ***the number of children in general***. But when the data are divided by gender, results showed that there was a significant association between BMI and ***number of children in women only***. There was a positive association between BMI and ***how often one ate at a restaurant weekly***, having a cook in the family, and ***degree of preferring salt in food***.
Al Rashdan and Al-Nesef (2010)[55]	Kuwait	Urban + rural	20-65	2280	Kuwaitis (918 males and 1362 females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Overweight and obesity rates were higher in women compared with men. Overweight and obesity were more prevalent in the older age group, aged 55 to 64 y.
Al-Isa (2003)[56]	Kuwait	Urban + rural	18 and older	5502	Kuwaitis (2626 males and	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric	Longer period of study, increased age, urban region, low education, being

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
					2876 females)				married, and not working were associated with higher BMI.
Ramadan and Barac-Nieto (2003)[57]	Kuwait	Urban	33.43 (1.30)	156	Kuwaitis (72 males and 84 females)	Sociodemographic factors "gender" and physical activity	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	**Sedentary and low-frequency physical activity groups** of both genders had higher BMI than **the active higher-frequency physical activity groups.** Males had higher fat-free mass than females. The means of fat-free mass and BMI of **sedentary females** were higher than those of **the more active females with higher frequency** of **physical activity.** In males but not in females, **low frequency (less than three sessions per week) of routine PA** was associated with lower body weight and body fat compared with **sedentary participants.**
Musaiger and Radwan (1995)[58]	Emirates	Urban + rural	18-30, 19.7 (1.30)	215	Female university students	Sociodemographic factors and dietary habits	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Obesity was the highest in females aged 18 y. There was no significant association between obesity and the social factors studied. The prevalence of obesity was higher in nonnationals, those with educated mothers, having no housemaid, and *having a family history of obesity. Skipping meals and snacks* had no significant association with obesity.
Al-Kilani et al (2012)[59]	Oman	Urban + rural	21.22 (1.37)	202	Omani university students (101 males and 101 females)	Sociodemographic factors, physical activity, and nutrition knowledge	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Male students had a higher prevalence of overweight and obesity than female students. **Physical inactivity** and *lack of basic nutritional knowledge about healthy foods and energy-dense foods* were the main factors associated with overweight and obesity among students.
Al-Nakeeb et al (2015)[60]	Qatar	Urban + rural	18-25, 21.3 (3.80)	732	University students (320 males and 412 females)	Sociodemographic factors, dietary habits, physical activity, and screen time	Obesity "BMI"	Self-administered survey	**Increased screen time, sedentary behaviour,** *unhealthy diet,* and **low PA** were associated with high BMI.
Borgan et al (2015)[61]	Bahrain	Urban + rural	30-69, 45 (10)	152	Physicians (50 males and 102 females)	Sociodemographic factors, sleep duration, physical activity, and screen time	Overweight and obesity "BMI"	Self-administered survey	Physicians with high BMI levels (more than 25) were more likely to be male, older, *report fewer than six sleep hours nightly,* and *have a known diagnosis of hypertension or hyperlipidaemia.* There were no

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									significant correlations between increased **screen time** and obesity.
Al Riyami et al (2010)[62]	Oman	Urban + rural	60 and older	2027	Elderlies (982 males and 1045 females)	Sociodemographic factors "gender"	Obesity "BMI"	Interview + survey by researcher	Women were more obese than men.
Hajat et al (2012)[63]	Emirates	Urban + rural	18 and older, 36.82 (14.30)	50 138	Emiratis residing in Abu Dhabi (43% males and 57% females)	Sociodemographic factors	Obesity "BMI and WC"	Self-administered survey + anthropometric measurements by specialized nurses	The crude obesity rate was higher among women than among men (38% vs 32%), whereas crude overweight (29% vs 36%) and central obesity (52% vs 59%) rates were lower among women. Males aged 20-29 were the most overweight and obese category. For females, 30-39 were the most obese and 20-29 the most overweight.
Mabry et al (2012)[64]	Oman	Urban + rural	20 and older, 36.3 (12.5)	1335	Omanis (591 males and 744 females)	Sociodemographic factors "gender" and physical (in)activity "transport inactivity and sitting time"	Obesity "BMI"	Self-administered survey + interview	**Physical inactivity** (transport inactivity in men and sitting time in women) was associated with high BMI.
Musaiger et al (2004)[65]	Qatar	Urban + rural	20-67	535	Arab females	Ideal body image	Obesity "BMI"	Self-administered survey	**Ideal body image** was not related to BMI.
Al-Lawati and Jousilahti (2004)[66]	Oman	Urban + rural	20 and older, 25.3 (5.20) and 25.5 (5.65)	11 486	Omanis (5197 males and 6289 females)	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Obesity was higher among men than women. Mean BMI increased with increasing age and peaked in the age group 40-49 in both genders. Obesity was found to be significantly higher among urban compared with rural populations and among southern regions compared with northern regions.
Musaiger and Al-Ansari (1991)[67]	Bahrain	Urban + rural	18 and older	420	Participants who attended a women's sports programme	Sociodemographic factors, socio-economic factors, and dietary habits	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Increased age, low education, unemployment, marriage, and **big family size** have a positive association with obesity, while **ownership of cars, availability of housemaids, family history of obesity**, and **meal patterns** have no significant association. There were no differences in source of nutrition information between obese and non-obese women.
Al-Mannai et al (1996)[68]	Bahrain	Urban + rural	20-64, 36.4 (13.85)	290	Bahrainis (137 males and 153 females)	Sociodemographic factors and socio-economic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Females had a significantly higher prevalence of overweight and obesity compared with males. Participants living in urban areas

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									had a greater tendency to be obese than those residing in rural areas. Marriage, ***ownership of a car, and a large family (more than seven members)*** were positively associated with obesity. The educational level was not associated with obesity in either males or females. The age of adult females was not found to be associated with obesity, whereas in males, the incidence of obesity was more frequent among those who were 50 y of age and above than among those under 50 y of age. Family monthly income was not associated with the incidence of obesity.
Shah et al (2015)[69]	Emirates	Urban	20-59, 34 (9.80)	1375	South Asian male migrants	Sociodemographic factors	Overweight and obesity "BMI"	Self-administered survey + anthropometric measurements by researcher	Nationality, increased age, high monthly salary, low education, working as a driver, salesman, or office worker, having a business or working as shopkeeper or tailor, type of current accommodation, urban residence in their country of origin, being married, longer duration of residency in the Emirates, and ***being hypertensive*** were the factors significantly associated with being overweight or obese.
Carter et al (2003)[70]	Emirates	Urban	19-27, 22	175	University medical students (30% males and 70% females)	Sociodemographic factors "gender"	Obesity "BMI"	Self-administered survey	Males were more likely to be overweight or obese than females.
Al-Riyami and Afifi (2003)[71]	Oman	Urban + rural	20 and older, 38.37 (16.65)	3506	Omani males	Smoking	Obesity "BMI and WHR"	Self-administered survey + anthropometric measurements by researcher	***Current smokers*** had low BMI compared with ***nonsmokers and ex-smokers. Current light smokers*** had low BMI compared with ex-smokers. No association of central obesity to ***smoking status*** was found.
Carter et al (2004)[72]	Emirates	Urban	20 and older	535	Females citizens of Al Ain	Sociodemographic factors "gender and education"	Obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	Obesity was associated with increased age and low education for women. ***Postmenopausal women had lower physical activity*** and higher rates of obesity than premenopausal women.

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
Rehmani et al (2013)[73]	Saudi Arabia	Urban	14 and older	1339	Adults living in National Guard housing in the eastern region (769 males and 570 females)	Sociodemographic factors "age, gender, and education"	Overweight and obesity "BMI"	Self-administered survey + anthropometric measurements and blood samples by trained staff	Men were significantly more overweight or obese than women. Overweight or obesity increased with age and decreased among participants aged 55 y or older. Higher overweight and obesity levels were related to lower education.
Khalid et al (1997)[74]	Saudi Arabia	Urban + rural	15-60 highlanders 35.2 (16.5) and lowlanders 34.8 (15.7)	498 highlanders (261) and lowlanders (237)	Arab and Saudi national males in Alraish, Alsoda, and Alsoga.	Sociodemographic factors "age" and area	Overweight and obesity "BMI"	Anthropometric measurements by researcher	Lowlanders were significantly heavier and taller than highlanders. However, there was no significant difference in BMI level between highlanders and lowlanders. In both highlanders and lowlanders, BMI increased gradually with increased age until the age of 50 y and decreased afterward.
Khalid and Ali (1994)[75]	Saudi Arabia	Urban + rural	Highlanders 17-72 and lowlanders 17-76	919 highlanders (451) and lowlanders (468)	Saudi citizens in Alraish and Alsoda highlanders (238 males and 213 females) and lowlanders (189 males and 279 females)	Sociodemographic factors "age and gender" and area	Overweight and obesity "BMI"	Anthropometric measurements by researcher	The highlanders (55.7%) were more overweight or obese than lowlanders (42.9%). Among highlanders only, women were significantly more overweight or obese than men. Both highlanders and lowlanders had higher prevalence of overweight or obesity after the age of 39 y.
Binhemd et al (1991)[76]	Saudi Arabia	Urban	18-74	1072	Patients who attended a primary health care centre of King Fahd Hospital of the University, Al-Khobar (477 males and 595 females)	Sociodemographic factors "gender and age"	Obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	Women had a higher obesity rate than men (31.26% vs 16.5%). Obesity was not significantly associated with age.
Al-Awadi and Amine (1989)[77]	Kuwait	-	-	2999	Females living in Kuwait	Sociodemographic factors	Obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	The prevalence of obesity increased gradually with age, low education, low level of husbands' education, low income, nonworking females, *increased family size, and large number of children.* However, the prevalence of overweight increased with decreased age, high education, high level of husbands' education,

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Area	Age, Range in Years and Mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									high income, females with a technical profession, *decreased family size, and low number of children.*
Kordy and El-Gamal (1995)[78]	Saudi Arabia	Urban	16 and older	1037	Saudi citizens in Queza district, Jeddah (611 males and 426 females)	Sociodemographic factors "age and gender"	Obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	BMI significantly increased with age. BMI was significantly higher in females compared with males.
Amine and Samy (1996)[79]	Emirates	Urban + rural	18 and older	566	Female university students	Sociodemographic factors, snack intake, physical activity, and napping	Obesity "BMI"	Self-administered survey + anthropometric measurements by trained staff	Obesity increased with increased age, *obesity during childhood, the presence of an obese parent or both*, and high food intake between meals and in particular fast foods. **Low levels of physical activity** and *long afternoon napping* were related to obesity.
Musaiger and Al-Mannai (2013)[80]	Kuwait	Urban + rural	19-25	228	Kuwaiti university female students	Media	Obesity "BMI"	Self-administered survey	Females with obesity were two to three times more likely to be *influenced by mass media to undergo dieting to lose weight* than those who were not obese. Differences were statistically significant for *reading women's magazines and using the internet*; however, *they were not significant for watching television.*

In the "Main Findings" column, physical (in)activity results are in bold font, dietary habits results are in italic font, sociodemographic results are in regular font, and miscellaneous results are in italic bold font.

TABLE 2 Descriptive summary of correlate studies of physical activity

Author (Year)	Country	Area	Age, range in years and/ or mean (SD)	Sample Size	Participants	Outcome Measure	Correlate Measure	By What Measure is the Correlate Evaluated	Main Findings
Sayegh et al (2016)[14]	Qatar	-	18-64, 37.4 (11.7)	549	Qatari females	Physical activity	Sociodemographic factors "age"	Self-administered survey	Results showed that middle-aged adult females (45-64 y) were more active, with a daily average of more than 7000 steps, compared with less than 5000 steps per day "sedentary" and 5000-7499 steps per day "low active" among age groups 18-24 y and 25-44 y, respectively.
Al-Nozha et al (2007)[16]	Saudi Arabia	Urban + rural	30-70, 46.3 (11.50)	17 395	Saudis (8297 males and 9098 females)	Physical activity "inactivity"	Sociodemographic factors	National Epidemiological Health Survey by researcher	There were significantly more inactive females (98.1%) than males (93.9%). Inactivity prevalence increased with increasing age category, especially in males, and decreased with increasing education levels. Inactivity was the highest in the central region and the lowest in the southern region of Saudi Arabia.
AlAteeq and AlArawi (2014)[18]	Saudi Arabia	Urban	39.2 (8.91)	322	Clinicians (127 males and 195 females)	Physical activity	Sociodemographic factors "gender" and dietary habits	Self-administered survey	There was no significant relation between age and physical activity level. Higher levels of physical activity were associated with better dietary habits. Females had higher physical activity levels than males. Nurses had higher physical activity levels than other clinicians.
Almajwal (2015)[23]	Saudi Arabia	Urban + rural	18 and older	362	Non-Saudi female nurses	Physical activity	Sociodemographic factors	Self-administered survey	Being married, working shift duty, and higher education level were predictors of low physical activity.
Khalaf et al (2013)[25]	Saudi Arabia	Urban + rural	20.4 (1.50)	663	Female university students	Physical activity	Sociodemographic factors	Self-administered survey	Low maternal level of education, being married, and living far from parks were related to low physical activity.
Samara et al (2015)[26]	Saudi Arabia	Urban	18-22, 20 (0.70)	94	Female university students	Physical activity	Sociodemographic factors "gender," internal factors, external factors, and obesity "BMI"	Self-administered survey	High sedentary behaviour was significantly associated with high BMI. Low self-efficacy was associated with low physical activity. Low physical activity was associated with lack of facilities and lack of encouragement.
Al-Otaibi (2013)[28]	Saudi Arabia	Urban + rural	20-56	242	Saudis (118 males and 124 females)	Physical activity	Sociodemographic factors	Self-administered survey + anthropometric measurements by researcher	More males than females were physically active. More males than females were already physically active for more than 6 mo (ie, in the maintenance phase). Females had more external barriers to and less self-efficacy for physical activity than males.
Amin et al (2011)[81]	Saudi Arabia	Urban + rural	18-64, 32.7 (9.80)	2176	Saudis (1209 males and 967 females)	Physical activity	Sociodemographic factors	Self-administrated survey	Being female, being older, living in an urban residence, having a higher educational, and occupational status were related to less physical activity.

(Continues)

TABLE 2 (Continued)

Author (Year)	Country	Area	Age, range in years and/ or mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Correlate Evaluated	Main Findings
									Low PA was associated with societal restrictions and traditions, especially among women and older age groups. Hot weather, lack of facilities, and time were the main associated barriers to low physical activity.
Al-Rafaee and Al-Hazzaa (2001)[82]	Saudi Arabia	Urban + rural	19 and older	1333	Saudi males	Sociodemographic factors	Physical activity	Self-administered survey + anthropometric measurements by researcher	Increased age was associated with inactivity; the middle age group was the least active. Physical activity was lower among those who were married, worked in the private sector, worked two shifts, were less well educated, or who had only 1 d off in the week.
Khalaf et al (2015)[83]	Saudi Arabia	Urban + rural	20.4 (1.50)	663	Female university students	Ideal body image	Physical activity	Self-administered survey	There was positive association between high physical activity levels and the desire to be thinner.
Al Dokhi and Habib (2013)[34]	Saudi Arabia	Urban + rural	18-72, 36.91 (15.22)	411	Saudis (300 males and 111 females)	Sociodemographic factors "gender"	Physical activity	Self-administered survey + anthropometric measurements by researcher	The prevalence of low physical activity was higher in females compared with males.
Awadalla et al (2014)[84]	Saudi Arabia	Urban + rural	17-25, 20.1 (1.40)	1257	University students (426 males and 831 females)	Sociodemographic factors	Physical activity	Self-administered survey + anthropometric measurements by researcher	Females were less likely to engage in vigorous physical activity than males. Females performed walking activities more frequently than males. Males had more inactive leisure time than females. Non-membership in sports clubs was related to a greater risk of physical inactivity. Among students at health colleges, colleges of medicine, pharmacy, dentistry, nursing, and applied medical science, students at the college of medicine were more likely to be physically inactive, while students of dentistry were the least likely to be physically inactive. Increased age, higher study level, high parental education/job status, and family income were no significant predictors of physical inactivity.
Albawardi et al (2016)[40]	Saudi Arabia	Urban	18-58	420	Saudi females working in office jobs	Sociodemographic and psychosocial factors	Physical activity	Self-administered survey + height and weight were measured	Females who work seven or more hours per day and do not have children and work in the private sector were less physically active. Social support and general self-efficacy were not associated with the level of physical activity. Health reasons and maintaining weight were the most

(Continues)

TABLE 2 (Continued)

important factors associated with high PA.

Author (Year)	Country	Area	Age, range in years and/ or mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Correlate Evaluated	Main Findings
Albawardi et al (2017)[85]	Saudi Arabia	Urban + rural	18-60	420	Saudi females working in office jobs	Sociodemographic factors	Physical activity "sitting time"	Self-administered survey	Workday sitting time was related to level of education (increase by 55 min as education level increased), number of children (sitting decreased by approximately 37 min with each additional child), and working in the private sector (sitting time increased by nearly 80 min per day on work days) compared with the public sector. Nonwork day sitting time was related to number of children (sitting decreased by 27 min with each additional child), marital status (being single compared with married increased sitting time by 73 min per day), and living in a small home compared with a medium home (sitting time reduced by 81 min per day).
Mandil et al (2016)[86]	Saudi Arabia	Urban	24-65, 33.11 (9.27)	360	Physicians (222 males and 138 females)	Sociodemographic factors	Physical activity and sedentary behaviour	Self-administered survey	Females were more likely to use the internet, than males. Prevalence of physical activity on a daily basis was higher among males (41.6%) than females (16%).
Allafi and Waslien (2014)[45]	Kuwait	Urban + rural	18-59, 26 (7.90)	1370	Kuwaiti males and females	Sociodemographic factors "gender and age"	Physical activity	Self-administered survey	Increasing age was related to reported inactive behaviour patterns. Women (especially overweight women) felt greater discomfort when exercising around others and disliked exercising more than men.
Al Zenki et al (2012)[46]	Kuwait	Urban + rural	20-86, M 39.1 (0.90) and F 40.9 (0.70)	1830	Kuwaitis (459 males and 533 females)	Sociodemographic factors "gender"	Physical activity	Self-administered survey + anthropometric measurements by researcher	More males (4.7% ± 1.2%) reported their activity levels as being "very active" than did females (1.3% ± 0.6%).
Al-Isa (2011)[48]	Kuwait	Urban + rural	18 and older	787	Kuwaiti university students (378 males and 409 females)	Sociodemographic factors, dental and health check-up, not desiring a higher degree, having no preferred countries for visiting, and obesity "BMI"	Physical activity	Self-administered survey + anthropometric measurements by researcher	Being female, married, not remembering the last dental and health check-up, not desiring a higher degree, having no preferred countries for visiting, and obesity were associated with low physical activity.
Musaiger et al (2014)[51]	Kuwait	Urban + rural	19-26, 21 (3)	530	University students (203 males and 327 females)	Sociodemographic factors and external factors	Physical activity	Self-administered survey	Men perceived far fewer barriers to physical activity (eg, time and climate) than did females.

(Continues)

TABLE 2 (Continued)

Author (Year)	Country	Area	Age, range in years and/ or mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Correlate Evaluated	Main Findings
Al-Asi (2003)[53]	Kuwait	Urban + rural	18 and older	3282	Kuwait oil company employees (2804 males and 478 females)	Sociodemographic factors	Physical activity	Self-administered survey + anthropometric measurements by researcher	Field workers had a higher level of inactivity outside working hours (65%) than did office workers (56%).
Musaiger et al (2015)[87]	Bahrain	Urban + rural	20.1 (2.00)	642	University students (90 males and 552 females)	Sociodemographic factors "gender"	Physical activity	Self-administered survey	Males (41.6%) were more physically active than females (16%).
Al-Nakeeb et al (2015)[60]	Qatar	Urban + rural	18-25, 21.3 (3.80)	732	University students (320 males and 412 females)	Sociodemographic factors and obesity "BMI"	Physical activity	Self-administrated survey	The percentage of inactive Qatari students is higher compared with non-Qatari students. Increased sedentary behaviour and high BMI were associated with low PA.
Borgan et al (2015)[61]	Bahrain	Urban + rural	30-69, 45 (10)	152	Physicians (50 males and 102 females)	Screen time	Physical activity	Self-administered survey	There were no significant correlations between increased screen time and lack of physical activity.
Al Riyami et al (2010)[62]	Oman	Urban + rural	60 and older	2027	Elderlies (982 males and 1045 females)	Sociodemographic factors	Physical activity	Interview + survey by researcher	Active respondent men were more physically active than women.
Mabry et al (2012)[64]	Oman	Urban + rural	20 and older, 36.3 (12.5)	1335	Omanis (591 males and 744 females)	Sociodemographic factors and dietary habits smoking	Physical (in)activity "leisure inactivity, inactivity at work, transport inactivity, and sitting time"	Self-administered survey	Transport inactivity increased with increased age among men. Leisure inactivity in men increased with low levels of education, unemployment, and being married. Leisure inactivity in women increased with unemployment and low FV intake. Women aged 40 y or more had higher inactivity levels at work compared with younger ones. Male smokers aged 30-39 y had higher mean sitting time than their nonsmoking counterparts. Women aged 20 to 29, unemployed women, and men with high educational level had higher mean levels of sitting time.
Mabry et al (2017)[88]	Oman	Urban	18 and older	2977	Omani (1490 males and 1487 females)	Sociodemographic factors	Physical activity	Self-administered survey	The prevalence of physical activity was higher in men compared with women and in younger participants compared with older ones. Physical activity varied significantly by region of residence, with the highest rate in South Batinah and the lowest in Dhofar and Al Wusta. Unmarried men aged 30-39 y were twice as likely to be physically active and unmarried women aged 40+ y were half as likely to be active as their married counterparts. Unemployed young women (18-29 y) were less active than employed women. Higher education was significantly associated with

(Continues)

TABLE 2 (Continued)

Author (Year)	Country	Area	Age, range in years and/ or mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Correlate Evaluated	Main Findings
									leisure physical activity for men (30 y or more) and women (40 y or more).
Mabry et al (2016)[89]	Oman	Urban	18 and older	2977	Omani adults (1490 males and 1487 females)	Sociodemographic factors + physical activity	Physical activity "sitting time"	Self-administered survey	The prevalence of prolonged sitting time (7 h/d or more) was higher in older participants (40 y or more) compared with younger ones (less than 40 y) for both genders. Those who were older (40 y or more), married, less well educated, unemployed, and not physically active had higher mean sitting times than their counterparts.
Carter et al (2003)[70]	Emirates	Urban	19-27, 22	175	Medical students (30% males and 70% females)	External and internal factors	Physical activity	Self-administered survey	Low physical activity was associated with lack of time and motivation.
Rehmani et al (2013)[73]	Saudi Arabia	Urban	14 and older	1339	Adults living in National Guard housing in the eastern region (769 males and 570 females)	Sociodemographic factors	Physical activity	Self-administered survey	Men were more physically active than women. Those who were between 25 and 34 y were the most physically active. Participants with more family members were physically less active.

prevalence of obesity,[21,40,69,77] others stated the opposite.[36,48] The majority of studies indicated that low educational level was associated with a high prevalence of obesity[15,21,30,33,38,56,67,69,71-73,77]; only one study contradicted this finding.[40] Obesity was higher among people without jobs, particularly housewives,[21,38,67,77] and rates were higher among people living in urban areas compared with people living in rural areas,[17,32,56,66,68,71] with the exception of two studies.[32,38]

Miscellaneous

The remaining studies on overweight/obesity correlates addressed miscellaneous factors. Obesity was higher among those who had parents or immediate relatives with obesity or lived with their parents.[20,30,47,48,52,58,79] The results of several studies also suggest that living together with more relatives is associated with higher weight.[54,68,77] The relation between smoking status and BMI/obesity was inconsistent between studies.[15,71,74] Recent studies have also investigated sleep in relation to weight/obesity in the Gulf States. Obesity was significantly associated with sleep disturbances[43] and short sleep duration.[41,42,61]

3.1.2 | Behavioural correlates of PA and sedentary behaviour

There were 29 studies on correlates of PA; the majority involved sociodemographic factors (see Table 2). Most studies on PA showed that women had lower PA levels than men.[16,28,34,45,46,48,73,81,84,89] Those who were older (40 y or more), married, less educated, unemployed, and not physically active had longer mean sitting times than younger ones.[88,89] However, one study showed that age was not a significant correlate of physical inactivity.[84] Another study showed that women aged 45 to 64 years were more active than younger women.[14] While some studies indicated that higher educational and occupational status were associated with lower PA in the Gulf States,[25,81] other studies showed the opposite.[82,84] Residing close to parks was related to higher levels of PA.[25] Furthermore, being married,[27,50] working in the private sector, working two shifts, or having only 1 day off during the week were associated with low PA.[14,23,82,85] Participants with more family members were physically less active.[73] Social support and general self-efficacy were not significantly associated with the level of PA.[14]

3.1.3 | Behavioural correlates of dietary behaviours

The 15 studies on correlates of dietary behaviours were mostly on sociodemographic factors; for details, see Table 3. The results are discussed based on the kind of dietary behaviour, ie, (a) FV intake, (b) fast food snacks and sugar intake, and (c) meal patterns and skipping meals.

FV intake

Studies in general showed a low consumption of FV (less than five servings a day) in the Gulf region.[29,31,64,90,93,95] Women consumed vegetables more frequently than men.[68,95] Men had a higher fruit intake than women.[87] The relation between level of nutritional

TABLE 3 Descriptive summary of correlate studies of dietary habits

Author (Year)	Country	Area	Age, range in years and mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
El Hamid (2011)[90]	Saudi Arabia	Urban	18-21	205	Female university students	Knowledge and behaviour	Dietary habits "FV consumption"	Self-administered survey	Students of the nutrition department consumed more vegetables than students from nonnutrition departments. Self-efficacy and benefits were the most important factors associated with FV consumption, while the department type had no association.
AlAteeq and AlArawi (2014)[18]	Saudi Arabia	Urban	39.2 (8.91)	322	Clinicians (127 males and 195 females)	Sociodemographic factors "gender" and physical activity	Dietary habits	Self-administered survey	Higher levels of physical activity were associated with better dietary habits. Better dietary habits increased with increased age and work experience. Females had better dietary habits than males. Physicians and nurses had better dietary habits than pharmacists.
Almajwal (2016)[24]	Saudi Arabia	Urban	18 and older	395	Non-Saudi female nurses	Stress and work shift duty	Dietary habits	Self-administered survey + anthropometric measurements by researcher	Results indicated that nurses with high stress and with undergraduate diplomas had less healthy eating behaviours: restrained eating (the tendency to restrict food intake in order to control body weight), emotional eating (the tendency to cope with negative emotions such as anxiety or irritability), and external eating (the extent to which external cues of food trigger eating episodes, such as the reinforcing value of the sight and smell of attractive food). Nurses working night shift duty had more restrained eating and external eating than those working the day shift. Most of the nurses working night shift duty ate more fast food and snacks and fewer vegetables than nurses who do not work on night shifts.
Al-Gelban (2008)[91]	Saudi Arabia	Urban + rural	18 and older	456	Saudi male college students	Sociodemographic factors	Dietary habits	Self-administered survey	There was no relationship between students' parental education and dietary habits.
El Hamid (2014)[27]	Saudi Arabia	Urban + rural	18-28, 20.78 (1.76)	400	Female university students	Sociodemographic factors	Home breakfast skipping	Self-administered survey	Unhealthy habits (overconsumption of junk foods and soft drinks, poor dairy intake, and sedentary lifestyle) were higher among home breakfast skippers. Unhealthy dietary habits, father's education being lower than university level, and father's unemployment status were related to their daughters' skipping breakfast. In addition, skipping breakfast is related to higher intake of energy-dense food.
Al-Otaibi (2013)[29]	Saudi Arabia	Urban + rural	21.74 (1.55)	960	Female university students	Fruit and vegetable consumption	Psychosocial factors	Self-administered survey + anthropometric measurements by researcher	Students with better dietary knowledge more often consumed five or more servings per day than others with low dietary knowledge. Students with high

(Continues)

TABLE 3 (Continued)

Author (Year)	Country	Area	Age, range in years and mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
									self-efficacy consumed more fruits and vegetables than students with low self-efficacy. Perceived barriers and knowledge were not related to recommended daily fruit and vegetable intake.
Khalaf et al (2014)[30]	Saudi Arabia	Urban + rural	18 and older, 20.4 (1.50)	663	Female university students	Sociodemographic factors	Dietary habits	Self-administered survey	Moderate activity level and low household monthly income of 3000 SAR or less were related to breakfast skipping. The intake of vegetables was lower only if the mother works, when siblings with obesity are present, with an increased intake if four siblings or more are obese and with high household income. There were negative associations between the intake of fruits and high number of sisters. On the other hand, the presence of obese siblings as well as high activity levels increased the students' intake of fruits. The age of the participants and their residency's proximity to supermarkets were negatively associated with the milk/dairy products intake. The intake of sugar-sweetened drinks was significantly associated with the participants' BMI. Further, fast food consumption was negatively associated with the students' age, low activity level, and number of cars in the house. There was a positive correlation between the intake of French fries and potato chips, BMI levels, and the presence of one obese parent. The consumption of sweets/chocolate decreased significantly with increased BMI and if only the mother worked, and it increased with increased proximity to malls and higher educational level of the father. The energy drink intake was a correlate of the mother's higher educational level and lower household income.
Musaiger et al (2014)[92]	Kuwait	Urban + rural	19-65	499	Arabs (252 males and 247 females)	Sociodemographic factors "gender" and knowledge	Fast food intake	Self-administered survey	Fast food frequency intake per week was higher among men than women. Men were more likely to consume large-size French fries (40.9% vs 34.0%) and soft drinks (37.3% vs 30.8%) than women. Men tend to eat more "double" burgers (52%) than women (29.9%).
	Kuwait	Urban + rural	21-77	424		Smoking	Dietary habits		

(Continues)

TABLE 3 (Continued)

Author (Year)	Country	Area	Age, range in years and mean (SD)	Sample Size	Participants	Correlate Measure	Outcome Measure	By What Measure is the Determinant Evaluated	Main Findings
Al-Kandari (2006)[54]	Kuwait				Kuwaitis (212 males and 212 females)			Self-administered survey + anthropometric measurements by researcher	No association was found regarding number of snacks eaten between meals daily and smoking habits.
Musaiger et al (2015)[87]	Bahrain	Urban + rural	20.1 (2.00)	642	University students (90 males and 552 females)	Sociodemographic factors "gender"	Dietary habits	Self-administered survey	Females consumed more afternoon snacks than males (respectively, 35% and 19%). Males (25.6%) had higher consumption of fast food than females (22.5%). Males (50%) had higher fruits intake than females (43.3%). Males (41%) consumed significantly more carbonated beverages than females (19.7%).
Al Riyami et al (2010)[62]	Oman	Urban + rural	60 and older	2027	Elderlies (982 males and 1045 females)	Sociodemographic factors "gender" and knowledge	Dietary habits	Interview + survey by researcher	Women had higher nutritional knowledge than men. Women consumed less milk and fewer milk products than men (14.1% vs 18.8%). The consumption of fish/meat/chicken, cereals, vegetables, or fruits was not statistically different between genders.
Mabry et al (2012)[64]	Oman	Urban + rural	20 and older, 36.3 (12.5)	1335	Omanis (591 males and 744 females)	Physical (in)activity "leisure inactivity"	Dietary habits "FV intake"	Self-administered survey	Leisure inactivity in women increased with less FV intake.
Musaiger and Abuirmeileh (1998)[93]	Emirates	Urban + rural	20 and older	2212	Emirati nationals (1122 males and 1090 females)	Sociodemographic factors "gender and age"	Dietary habits	Self-administered survey	Men and older participants consumed food more often per day than did women and younger participants, respectively. Elderly people were more likely to consume traditional foods such as fish and laban (diluted yoghurt) than young people. Eggs, cheese, and chicken were found to be consumed significantly less often by older men than young men. Women consumed chicken, vegetables, bread, tea with milk, eggs, and cheese more frequently than men.
Al-Thani et al (2017)[94]	Qatar	Urban + rural	18 and older	3723	Qatari and non-Qatari households	Sociodemographic factors	Dietary habits	Self-administered survey	Findings showed that the Qatari households purchased nearly 1.5 times more food in grams per capita per day (2118 g/capita/d) compared with the non-Qatari households (1373 g/capita/d); however, the percentages of food groups in the basket were similar for both groups. Average daily energy (kcal) purchased per capita was almost double among Qatari household (4275 kcal) vs non-Qatari household (2424 kcal).
Zaghloul et al (2012)[95]	Kuwait	Urban + rural	18 and older 38.9 (12.2)	9350	Attendees at the Kuwait Medical Council and Public Authority for Social Security facilities (4462 males and 4888 females)	Age, smoking, and physical inactivity	Fruit and vegetable consumption	Self-administered survey + anthropometric measurements by researcher	Daily fruit and vegetable intake increased with age and BMI but decreased with smoking and physical inactivity.

TABLE 4 Descriptive summary of eligible intervention studies

Author (Year)	Country	Age, range in years and mean (SD)	Sample Size	Participants	Study Design	Intervention Description	The Timing of the Measurements	Outcome Measurement	Main Findings	Limitations in Articles	Recommendations in Articles
Al-Sarraj et al (2009)[96]	Emirates	18-50	56 after dropout 39 (14 males and 25 female)	Emiratis with metabolic syndrome	Randomized trial comparing two diets	Carbohydrate restriction diet vs carbohydrate restriction diet followed by the conventional low-fat diet (3 mo)	At baseline, week 6, and week 12	Fasting plasma lipids, 24-h dietary recalls, body composition, anthropometric, blood pressure, glucose, insulin, and plasma markers of inflammation	After 6 wk, reduced body weight (−13%), waist circumference (−4.5%), and body fat (−10.6%) were shown. After 12 wk, positive changes continued for all participants following the diet. However, body weight was lower in the carbohydrate restriction diet group than in the carbohydrate restriction diet followed by the conventional low-fat diet group.	-	-
Yar (2008)[97]	Saudi Arabia	18-25	106	Saudi male university students in medicine and allied medical sciences	Posttest study	Experiment in physiology course (2 wk, two sessions, 2 h per session)	At the end of the second session	Motivation to increase physical activity, increase healthy eating habits, and increase knowledge about obesity	74% of students were motivated to engage in more physical activity, 63% of students to adopt healthier eating habits, and 67% of students to enhance their knowledge about obesity. Furthermore, students were motivated to actively engage in the measurement of their BMI.	It is hard to evaluate if intention (reported change in thinking) about the modification of lifestyle will translate into a change in behaviour of the participating students.	
Sadiya et al (2016)[98]	Emirates	18-50	45	Emirati females with obesity or with obesity and type 2 diabetes	Pretest-posttest study	LIFE-8: dietary intervention, physical activity intervention, and behavioural therapy (eight sessions of education and counselling, five in groups, three or more	At baseline, month 3 and follow-up at month 12	Body weight, fat mass, waist circumference, blood pressure, fasting blood glucose, haemoglobin A_{1c}, and nutritional knowledge	The intervention resulted in a reduction of 5.0% in body weight (4.8 ± 2.8 kg; 95% CI, 3.7-5.8), fat mass (−7.8%, $P < 0.01$), and waist circumference (Δ = 4 ± 4 cm, $P < 0.01$) in the participants who completed the	Small sample size. There is no control intervention programme and the sample included only women.	Additional evidence from a randomized, controlled trial is essential to evaluate the short-term and long-term clinical advantages and cost-effectiveness of the LIFE-8 programme in this

(Continues)

TABLE 4 (Continued)

Author (Year)	Country	Age, range in years and mean (SD)	Sample Size	Participants	Study Design	Intervention Description	The Timing of the Measurements	Outcome Measurement	Main Findings	Limitations in Articles	Recommendations in Articles
						individual sessions)			intervention (n = 28). Increase in nutritional knowledge (less than 0.01) and overall evaluation of the programme (9/10) was favourable. On 1-y follow-up, the participants could sustain weight loss (−4.0%).		region. Since it is an ongoing programme, further studies with a larger sample size could provide insight into the generalizability of the results.
Midhet and Sharaf (2011)[99]	Saudi Arabia	20 and older	Baseline 1254 (70.7% males, 29.4% female) and follow-up 1011 (65.3% males, 34.7% female)	Primary health care centres' visitors	Pretest-posttest study with different samples at pretest and posttest	Health education intervention (10 mo)	At baseline and at month 10	Knowledge level, unhealthy dietary habits, regular exercise, and smoking	The intervention resulted in a decrease in the consumption of kabsa, bakery items, and dates and an increase in fish and fresh vegetables. Participants were less likely to smoke and more likely to do regular exercise. No significant impact of the intervention on the female population with regard to exercise.	Uncontrolled pretest-posttest, with different samples at pretest and posttest.	Promoting healthy lifestyles and informing the public on the hazards of leading a sedentary life, and engaging in unhealthy practices is the only way to control and contain the unprecedented increase in lifestyle related diseases in Saudi Arabia.
Albassam et al (2007)[100]	Saudi Arabia	18-40	212	Saudi females attending diet clinics	Pretest-posttest study	Weight management programmes: four different diet programmes and one physiotherapy exercise programme	At baseline, and at the end of each programme (varies from 6 wk up to 10 mo)	Weight loss (%)	Moderate hypocaloric plan diet had, compared with the other four groups, the lowest per cent weight loss (7.8%) and the least side effects. Both groups under very low-calorie diets and protein diets had the highest per cent weight reduction (13.2% and 12.3%) with the highest number of side effects.	-	Use of the primary approach for achieving weight loss through therapeutic life style change is recommended.
Alghamdi (2017)[101]	Saudi Arabia	20 and older	140 (70 males, 70 female)	Arab participants		Intensive lifestyle intervention (ILI)		Weight loss (%)	Participants in ILI programme more	High attrition rates, 36% of the	Similar programmes are needed to be

(Continues)

TABLE 4 (Continued)

Author (Year)	Country	Age, range in years and mean (SD)	Sample Size	Participants	Study Design	Intervention Description	The Timing of the Measurements	Outcome Measurement	Main Findings	Limitations in Articles	Recommendations in Articles
				with obesity who were otherwise healthy	Randomized controlled trial	programme; diet, exercise, and behavioural techniques using goal setting, self-monitoring, and stimulus control (eight visits) vs active comparator programme (received only an initial health education session)	At baseline and follow-up at month 3		often achieved a 5% weight reduction and showed significantly greater weight loss at 3 mo than the active comparator group.	participants dropped out of this study. No follow-up for a longer period.	implemented in the region. Further research is essential to evaluate the long-term effectiveness of ILI among obese population and to identify effective methods for long-term weight-loss maintenance.
Armitage et al (2017)[102]	Kuwait	30.11(11.2)	216 (61 males, 127 female, 28 unknown)	Participants enrolled in a weight-loss programme	Randomized controlled trial	Weight-loss intervention programme using volitional help sheet to form implementation intentions vs the control group (use the volitional help sheet to think about critical situations and appropriate responses)	At baseline and at month 6	Weight loss (%)	At 6 mo, the intervention group lost significantly more weight (6.15 kg; −6.58% initial body weight) than those in the control group (3.66 kg; −4.04% initial body weight).	No follow-up for a longer period, small sample size; all subjects were in treatment, and they were highly motivated to lose weight, no published protocol or data analysis plan prior to data collection, bias due to simple randomization method.	-

knowledge and FV consumption was inconsistent.[29,90] High self-efficacy was associated with high FV intake.[20,90] Perceived benefits such as weight maintenance, preventing disease, and feeling better were significant correlates for increased FV consumption.[90] Daily FV intake increased with age and BMI but decreased with smoking and physical inactivity.[95]

Fast food snacks and sugar intake

Fast food intake and soft drinks consumption were higher among men than women.[86,87,92] Another study indicated that most of the nurses who worked shift duty ate more fast food and unhealthy snacks.[24] More women than men ate afternoon snacks,[86,87] and women consumed more of sugar-sweetened fruit drinks.[86]

Meals patterns and skipping meals

Irregular and infrequent meals were the most common unhealthy eating habits of the participants.[31] The elderly tended to eat traditional foods such as fish and yoghurt more than did younger people.[93] Unhealthy habits such as fast food and soft drinks intake, low dairy consumption, and sedentary lifestyle were higher among people who skip breakfast.[27]

3.2 | Intervention studies

Seven intervention studies were found[96-102]; see Table 4. Three were on women,[96,98,100] one on men,[97] and three on both genders.[99,101,102] Four were conducted in Saudi Arabia,[97,99-101] two in the Emirates,[96,98] and one in Kuwait.[102] The interventions evaluated in the studies are heterogeneous with respect to the intervention's target group (eg, students, people with overweight, and people with metabolic syndrome), the duration and intensity of the intervention (interventions of a few sessions to interventions lasting 10 mo), and whether the intervention addressed dietary behaviours, PA, or both. Interventions also differed on whether theoretical or behavioural strategies were used for development and which theoretical and behavioural strategies were used, if any (eg, implementation intentions, goal setting, and self-monitoring). Regarding the design of the evaluation studies, the picture is also quite heterogeneous; most studies lacked a control group or a baseline measurement; time to follow-up was usually limited, but it varied considerably (no follow-up to 1-y follow-up). Outcome measures also varied considerably (eg, in several studies, the outcome was reduction in weight and/or WC; in another, changes in dietary and exercise behaviour; and in one study, "motivation to engage in more physical activity and healthier eating habits"). Most studies reported significant changes in the reported outcome measures. However, these changes are difficult to interpret because of limitations in, for example, the design of the study (eg, no control group), small sample size, high attrition rate, or uncertain relevance of the outcome measure for weight loss.

4 | DISCUSSION

This systematic review aimed at identifying studies on correlates and interventions for overweight/obesity or weight-related behaviours among adults living in the Gulf States.

Most correlates of overweight/obesity identified in this review involved sociodemographic factors. Whereas a limited number of dietary, PA, and sedentary behaviours were explored, some recent studies investigated the relation between sleeping behaviour and obesity. The eligible correlate studies were all cross-sectional except for one.[14] Only a few behavioural correlate studies applied theoretical models of behaviour change or some of those models' constructs (eg, self-efficacy, attitude, barriers, social norms, and knowledge). Sociocognitive or environmental factors associated with overweight/obesity have hardly been investigated in the Gulf States.

Findings showed that PA, sedentary behaviour, dietary behaviours, and sociodemographic factors were the main correlates of overweight/obesity among adults in the Gulf States. The Gulf States share an obesogenic environment, with a rapid nutritional transition from traditional healthy foods and a high level of PA to large quantities of unhealthy energy-dense foods combined with a sedentary lifestyle and minimal PA. Clustering of unhealthy behaviours was sometimes found in these studies. Low PA and increased sedentary behaviours were associated with increased food consumption and higher BMI. Eating behaviours associated with obesity included low FV intake, high consumption of fat, high fast food intake, high soft drinks consumption, and eating with friends or eating out. In general, these results on the behaviours related to overweight and obesity are consistent with previous reviews in the rest of the world.[103,104]

Most identified studies on sociodemographic correlates of overweight/obesity revealed that increased age, being married, low education, urban residence, and unemployment were correlates of overweight/obesity. Married couples are physically less active than singles, and they are likely to eat together, which may encourage the increased consumption of food. These findings are similar to other reviews reported elsewhere.[103,105,106]

There were a few studies that indicated the association between obesity and short sleep duration.[41,42,61] Some more recent studies showed that lack of high-quality sleep is related to higher weight indices.[107-109] This finding is consistent with relatively recent evidence that shows that short sleep duration has a direct effect and an indirect effect (via behaviour) on weight.[107] Short sleep duration is related to metabolic changes leading to weight gain (direct effect) and to behavioural changes such as higher caloric food intake and less PA (indirect effect). Such studies in the Gulf States were conducted relatively recently, and more in-depth investigation is needed in this area.

Sociodemographic factors were the most often reported factors associated with PA behaviours. Being female and being older were associated with low PA. Compared with men, women with obesity are more uncomfortable exercising around others because of cultural sensitivities. Extremely hot weather, sand storms, urbanized environment, and passive transport opportunities were sometimes mentioned as barriers to being physically active.[26,28,70,81,87] Due to the very high temperatures, there is a lack of green walkable trails and parks in general, representing an absence of natural environmental cues to engage in active transport. Such sociocognitive and environmental determinants of weight-related behaviours may differ substantially from those in North America, Europe, or Oceania. This makes it even more important to execute determinant studies in the Gulf States in order to provide specific and relevant factors for intervention.

Correlates of dietary behaviours included mainly sociodemographic factors and sometimes sociocognitive factors. High self-efficacy and knowledge were associated with high FV intake. Socializing was shown to be a major correlate of the high consumption of unhealthy diets in the Gulf States. People tend to gather together and eat food that is very high in calories, mainly carbohydrates and fat.[5]

So in general, the reviewed correlate studies showed that the correlates of overweight/obesity, physical (in)activity, and dietary behaviours do not seem to be very different from correlates found in Western countries. However, it should be noted that differences between the Gulf States and Western cultures are especially likely to relate to the sociocognitive, cultural, and environmental correlates of dietary behaviours and PA. Environmental determinants of weight-related behaviours, such as infrastructure, weather, urbanized environment, and passive transport opportunities, were rarely investigated but sometimes came up in studies as barriers to PA.[26,28,70,81,87] Sociocognitive and cultural correlates of dietary behaviours and PA were also rarely investigated. However, some of the identified studies report on factors such as the consumption of traditional foods that are high in calories or the tradition of food hospitality that prescribes the host to offer far too much food to guests, which they have to eat in order to avoid being impolite.[22] Another study reports on norms and traditions as barriers to PA for females.[81] Such factors are probably more typical for the Gulf region.

Only seven interventions[96-102] seem to have been evaluated, ranging from interventions focusing on diet alone, to an intervention using behavioural therapy, to a health education weight-loss intervention programme. The studies suggest that these interventions produced some improvement in energy balance–related behaviours and weight status. Although the prevalence of overweight/obesity in the Gulf States is among the highest in the world, relevant interventions were scarce. Most of the interventions were not theory based and were often directed at populations with overweight and obesity. No intervention was found for the general population. The studies and findings were too limited and diverse to draw clear conclusions on what kind of intervention would be most suitable for adults living in the Gulf States. However, also in the Gulf States, intensive lifestyle interventions using behavioural strategies seemed promising,[101,102] as seems to be the case in the rest of the world.[110,111]

The results of this systematic review indicate that observational research on correlates of weight-related behaviours in the Gulf States is underdeveloped despite the seriousness of the issue. There is a need to establish well-designed, theory-based studies on behavioural and environmental determinants for dietary and PA behaviours in the region in order to inform and develop health promotion interventions that target these weight-related behaviours. Interventionists in the Gulf States cannot rely on empirical results from studies that have been executed in other regions, as the relevant factors are likely to differ. Longitudinal studies will be more effective in investigating these correlates as causal effects.

Furthermore, the stage of life may be important; eg, opportunities to be physically active may decline as people get older. Therefore, there is a demand for interventions that employ a sustained lifestyle approach, which integrates knowledge and the promotion of personal opportunities in order to adapt behaviours that facilitate the maintenance of energy balance.[112] Applying theoretical frameworks may increase the effectiveness of developing interventions and potentially help in producing data that can be evaluated in more efficient and effective ways.[112] It is essential that future interventions and related research apply systematic approaches in the design, implementation, and long-term evaluation of interventions.

Many reviews investigated these topics in Western countries. However, our systematic review is the first to explore these topics in the Gulf region. Previous reviews were more focused and specific, whereas ours took a broader and more comprehensive approach combining both correlates and interventions. Reversed causality between associated variables could possibly have biased the results due to the cross-sectional designs in almost all of the studies reviewed. For example, it is hard to determine whether PA affects BMI or vice versa. All data were self-reported, except for BMI in some studies, and were subject to reporting bias. Another limitation is the consistent use of questionnaires for data collection, which may be subject to recall and estimation bias. Despite the fact that there was no language restriction, all of the studies were published in English; it is possible that publications in other languages were not found due to the databases used.

5 | CONCLUSION

Available evidence shows that the most important and consistent correlates of overweight/obesity in the Gulf States are physical inactivity, low FV intake, high consumption of fat, high fast food intake, and high soft drinks consumption. Research on determinants of weight-related behaviours in the Gulf States is scarce. Evidence-based and theory-driven behavioural interventions for healthy populations are not available. Establishing theory-based studies on behavioural determinants of dietary and PA behaviours in the region is essential. Based on the outcomes of such studies, evidence-based health promotion interventions that target these weight-related behaviours can be designed. More and more, the requirement for such interventions will be that they promote not only healthy diets and activities but also diets and physical activities that are sustainable.[113]

CONFLICTS OF INTEREST

No conflict of interest was declared.

ORCID

Abdulaziz Balhareth https://orcid.org/0000-0003-2226-5985

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SUPPORTING INFORMATION

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