LIFESTYLE, DIETARY HABITS AND PREVALENCE OF OBESITY AMONG FEMALE OFFICE EMPLOYEES AT QASSIM UNIVERSITY, SAUDI ARABIA

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Abstract. The prevalence of overweight and obesity in human societies is associated with many chronic syndromes, such as heart disease, high blood pressure and diabetes. The prevalence of obesity is 33.7% in the Kingdom of Saudi Arabia. A cross-sectional study was conducted on a cohort of randomly selected 132 female office employees at Qassim University, excluding pregnant women and breastfeeding mothers. The study aimed to identify dietary habits and lifestyle associated with obesity using a questionnaire and personal interviews. The majority of participants also attended a lecture on food educational program, and after one month, were assessed on the outcomes of their dietary habits, lifestyle and body physical parameters. The prevalence of overweight and obesity was 38 and 45% respectively. Lunch was the main meal, but nearly half of the participants neglected breakfast; the majority did not consume sugary juices; and ate while watching television or a mobile device, and also when upset or depressed. Slightly over half of the female office employees regularly conducted physical exercise, 1-2 times a week for two hours or less. Daily nutrient intake of energy, protein, carbohydrates, and vitamins was within the recommended allowances, but below the accepted range for fiber, unsaturated fat, vitamins B3, B6, C, and D, and the essential chemical elements, while that of sugar was higher. Attendance of the lecture resulted in only minor changes in the participants' dietary habits and lifestyle: attention to reducing calorie intake and taking more exercise. On average, there is a significant decrease in waist circumference and total body water mass, an increase in the body percent fat mass, but no change in body mass index.

In conclusion, the study highlights the need for more awareness of the high prevalence of overweight/obesity among Saudi female office employees and for a better knowledge of ways to maintain a healthy weight and avoid the overweight/obesity-related health risks.

Keywords: dietary habit, education, female office employee, obesity, overweight

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INTRODUCTION

Obesity is one of the global epidemics, which affects people of all ages: approximately 30% of adults globally, and this percentage is projected to increase to 33% by 2030 (Silveira *et al*, 2022). Obesity prevalence is associated with physical inactivity, poor dietary habits and sedentary behavior (Silveira *et al*, 2022), and with the rise in the prevalence of chronic diseases, such as cardiovascular disease, cancer and type 2 diabetes (WHO, 2025; Hruby and Hu 2015). Among women, obesity prevalence (40%) is higher than among men (35%) (Muscogiuri *et al*, 2024).

Anthropometry, the study and follow-up of changes in body mass index (BMI), percent body fat and obesity prevalence, is an important field of research as it allows assessment of the level of physical condition and nutritional status of children and adults (de Pee and Bloem 2009; Sung *et al*, 2009; Taheri and Kazemi, 2009). Due to the spread of overweight and obesity in various societies, scientists and researchers are interested in studying the causes and factors of obesity in view of its association with various health conditions as aforementioned. One of the most important causes of overweight and obesity is a lack of awareness of a healthy diet.

Access to information on proper nutrition is an important step to stem the rise of the obesity epidemic (WHO, 2010; Boutelle *et al*, 2012).

Saudi Arabia ranks as the fifteenth highest country in percent population obesity (33.7%) (WHO, 2016). Thus, the study was conducted to identify lifestyle habits, nutritional status and their relationship to the prevalence of obesity among female office employees at Qassim University, Buraydah. The study measured various anthropometric indicators, assessed nutritional status and overweight and obesity prevalence, and evaluated the effects of an educational program on changes to dietary habits and lifestyle among the participants.

The findings can help health authorities in Saudi Arabia better understand obesity-related risk factors among working women to implement or improve workplace wellness initiatives. Evaluating the impact of an educational program can demonstrate the importance of nutrition education in modifying unhealthy dietary behaviors, supporting the incorporation of similar programs across institutions.

MATERIALS AND METHODS

Study design and participants

A cross-sectional survey was conducted on a sample of randomly selected female office employees at Qassim University, Buraydah, Saudi Arabia. Pregnant and breastfeeding women were excluded from the study. Data were obtained using a questionnaire. The sample size was calculated employing the following equation (Thompson *et al*, 2012).

$$n = Np(1-p)/(N-1)(d^2/z^2) + p(1-p)$$

where n = required sample size

N = population size

p	=	estimated prevalence/proportion
d	=	acceptable error
z(-score)	=	confidence level

If N = 200, z-score = 1.96, d = 0.5, and p = 0.50, the calculated sample size is 132, which was the number of participants enrolled in the study.

Questionnaire and data collection

An invitation was sent via a smartphone to all qualified individuals, which explained the objectives of the study, all the procedures required from each participant, the anonymization of the returned questionnaire before data collection, the date of commencement of the study, the time required for return of the answered questionnaire, and a consent form. Agreement to participate in the study required returning the signed consent form (via smartphone). The questionnaire was divided into two parts: one part sent directly via smartphone to the participants to fill out and return as indicated above, and replies to the other part were collected from each participant by one of the authors. The questionnaire was tested for accuracy and reliability by 20 female individuals to obtain the final version.

The questionnaire consisted of the following sections.

Demographic information: age; weight (kg; without shoes); height (m); waist circumference (cm; wearing loose clothing); marital status; number of children; level of education; average monthly income.

Health history: presence of chronic disease in participant and family members; obesity among family members.

Dietary habit: number of daily meals partaken; favorite cooking method; type of main meal; most neglected meal; drinking sugary

juice; eating snacks in the middle of the night; eating while watching television or a mobile device; eating when depressed or upset.

Lifestyle: taking exercise (*eg*, aerobics, swimming, walking); if yes, number of times per week; if yes, average duration, hour(s); mean of transportation to and from workplace; daily working hours; daily movements between offices at workplace; use of elevator at workplace; daily time spent using computer, hour(s); daily time spent watching television/smart device (*eg*, mobile phone/iPad), hour(s); daily hours of sleep; assistance of housework helper.

A questionnaire on 24-hour food intake was conducted by interviewing each participant. An Esha software program (ESHA Research Inc, Salem, OR) was used to quantify the nutrient content of the food consumed by each participant over a 24-hour period. The Esha software program was based on the input of the nutrient compositions of Saudi dishes recorded in the Arabic Food Composition Database version of myfood24 (Bawajeeh *et al*, 2021). For packaged/brand products, nutrient information was obtained from the manufacturer labels and, when needed, from the Saudi Food and Drug Authority (SFDA) food labelling homepage (https://www.sfda.gov.sa/en/foodlabeling-calculator?). The food contents were analyzed for carbohydrates, energy, essential elements (calcium, iron, magnesium, manganese, phosphorous, potassium, selenium, sodium, and zinc), fats (saturated and unsaturated), fiber, folate, pantothenic acid, protein, sugar, and vitamins (A, B1. B2, B3, B6, B12, C, D, and E).

Body measurements

A fixed meter was used to measure the length of female employees, and a 1,000-square-meter striped meter was used to measure waist circumference in centimeters at the smallest abdomen circumference parallel to the ground. The TANITA SCALE

TBF-410 (Tanita Corporation of America, Arlington Heights, IL) was used to measure weight, body mass index (BMI), basal metabolic rate, fat weight, fat percentage, non-greasy tissue mass (muscle), and water content in the body, providing accurate results. Female employees must be shoeless and lightly clothed to ensure correct measurements results.

Food education program and outcome assessment

The educational program consisted of a 1-hour lecture presented on Qassim University website, BLACKBOARD, for 5 consecutive days to allow all participants sufficient opportunity to view the lecture. The lecture provided information on such topics as nutritional terms (nutrition, diet, balanced diet); nutrients (energy, protein, fat, carbohydrate, vitamin, essential chemical element); how to calculate food ration, calorie intake and BMI; classification of normal weight, overweight and obesity; appropriate physical activity; and an explanation of daily nutrients intake in comparison with the recommended dietary allowances (RDAs).

The outcome of the food educational program was assessed one month after viewing the lecture through a questionnaire sent via smartphone on the participant's understanding of the lecture's main content and how her dietary habits and food consumption behavior had changed.

Statistical analysis

Statistical differences were determined using Chi-square or one-way ANOVA tests, with a p-value ≤ 0.05 considered significant. Calculations were performed using the Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp, Armonk, NY).

Ethical consideration

The study protocols were approved by the Committee of Health Research Ethics, Deanship of Scientific Research, Qassim University (no. 21-03-03). Prior

written consent was received from each participant *via* smartphone.

RESULTS

Demographic characteristics

The 132 female office employees at Qassim University were divided into three groups based on their weight - normal (n = 22, BMI = 18.5-24.9 kg/m^2), overweight (n = 50, BMI = 25.0-29.9 kg/m^2) and obese (n = 60, BMI = >30.0 kg/m^2) - with 17, 38 and 45% categorized into normal weight, overweight and obese group, respectively. The highest proportion of the participants was 30-40 years of age (74%), married (89%), with >3 children (42%), and in the obese weight range (45%) (Table 1). Participants (71%) held a bachelor's degree, and 59% earned a monthly salary >SAR7,000 (>USD1866).

Health history

The majority of the participants (74%) reported no history of chronic disease, but a slim majority (51%) indicated chronic disease, and a low proportion (36%) had obesity in the family (Table 1).

Dietary habit

The majority (82%) of the participants took 2-3 meals daily, with a minority (1%) consuming more than 5 meals per day (Table 1). Participants (54%) preferred their food to be grilled, and 29% liked the food to be boiled. Lunch was the primary meal for 41% of the office employees, with 43% often missing breakfast. The majority (76%) abstained from sugary juices. A large proportion (62%) ate (always or sometimes) while watching television, 45% had (always or sometimes) late-night snacks, and 43% took to eating (always or sometimes) when depressed or upset.

Lifestyle

A large majority (70%) of office employees undertook some form of exercise, the majority (53%) for 1-2 times per week and daily among a small proportion (18%), with each session lasting <1 hour

Table 1

Demographic characteristics, health history, dietary habit, and physical activity of female office employees, Qassim University, Saudi Arabia

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Demographic characteristic					
Age					
20-30 years	5 (4)	1 (5)	2 (4)	2 (3)	0.38
>30-40 years	98 (74)	18 (82)	40 (80)	40 (67)	
>40 years	29 (22)	3 (13)	8 (16)	18 (30)	
Marital status					
Not married	14 (11)	3 (14)	4 (8)	7 (12)	0.52
Married	118 (89)	19 (86)	46 (92)	53 (88)	
Number of children					
0	18 (14)	4 (18)	6 (12)	8 (13)	0.91
1	11 (8)	2 (9)	6 (12)	3 (5)	
2	19 (14)	3 (14)	7 (14)	9 (15)	
3	29 (22)	6 (27)	11 (22)	12 (20)	
>3	55 (42)	7 (32)	20 (40)	28 (47)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Education level					
Secondary	28 (21)	1 (5)	10 (20)	17 (28)	0.11
Diploma	4 (3)	0 (0)	3 (6)	1 (2)	
University	94 (71)	21 (95)	34 (68)	39 (65)	
Postgraduate	6 (5)	0 (0)	3 (6)	3 (5)	
Average monthly income					
SAR3,000-5,000	19 (15)	3 (14)	2 (4)	14 (23)	0.05
SAR>5,000-7,000	35 (26)	4 (18)	17 (34)	14 (23)	
SAR>7000	78 (59)	15 (68)	31 (62)	32 (54)	
Health history					
Suffer from chronic disease					
No	98 (74)	17 (77)	35 (70)	46 (77)	0.68
Yes	34 (28)	5 (23)	15 (30)	14 (23)	
Existence of chronic disease among family members					
Yes	68 (51)	11 (50)	28 (56)	29 (48)	0.72
No	64 (49)	11 (50)	22 (44)	31 (52)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Existence of obesity among family members					
Yes	48 (36)	3 (14)	16 (32)	29 (48)	0.01
No	84 (64)	19 (86)	34 (68)	31 (52)	
Dietary habit					
Number of daily meals partaken					
2-3	108 (82)	17 (77)	42 (84)	49 (82)	0.79
3-4	23 (17)	5 (23)	8 (16)	10 (17)	
>5	1 (1)	0 (0)	0 (0)	1 (1)	
Favorite cooking method					
Boiling	38 (29)	8 (37)	10 (20)	20 (33)	0.50
Grilling	72 (54)	10 (45)	31 (62)	31 (52)	
Frying	22 (17)	4 (18)	9 (18)	9 (15)	
Main meal					
Breakfast	33 (25)	5 (23)	12 (24)	16 (26)	0.89
Lunch	54 (41)	9 (41)	23 (46)	22 (37)	
Dinner	45 (34)	8 (36)	15 (30)	22 (37)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Most neglected meal					
Breakfast	57 (43)	11 (50)	27 (54)	19 (32)	0.13
Lunch	37 (28)	7 (32)	10 (20)	20 (33)	
Dinner	38 (29)	4 (18)	13 (26)	21 (35)	
Drink sugary juice					
Yes	32 (24)	6 (27)	11 (22)	15 (25)	0.88
No	100 (76)	16 (73)	39 (78)	45 (75)	
Eat snacks in middle of the night					
Always	15 (12)	1 (4)	7 (14)	7 (12)	0.80
Never	73 (55)	14 (64)	27 (54)	32 (53)	
Sometimes	44 (33)	7 (32)	16 (32)	21 (35)	
Eat while watching television or mobile device					
Always	31 (23)	7 (32)	12 (24)	12 (20)	0.74
Never	50 (38)	9 (41)	18 (36)	23 (38)	
Sometimes	51 (39)	6 (27)	20 (40)	25 (42)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Eat when depressed or upset					
Always	30 (23)	3 (14)	12 (24)	15 (25)	0.63
Never	76 (57)	15 (68)	30 (60)	31 (52)	
Sometimes	26 (20)	4 (18)	8 (16)	14 (23)	
Lifestyle					
Taking exercise (*eg*, aerobics, swimming, walking)					
Yes	92 (70)	16 (73)	36 (72)	40 (67)	0.79
No	40 (30)	6 (27)	14 (28)	20 (33)	
If yes, number of times per week (N = 92)[c]					
1-2	49 (53)	10 (63)	19 (53)	20 (50)	0.99
3-4	23 (25)	3 (19)	9 (25)	11 (27)	
5-6	3 (4)	1 (6)	1 (3)	1 (3)	
Daily	17 (18)	2 (12)	7 (19)	8 (20)	
If yes, average duration, hour(s) (N = 92)[c]					
<1	57 (62)	7 (44)	24 (67)	25 (62)	0.37
1-2	26 (28)	7 (44)	9 (25)	11 (28)	
>2	9 (10)	2 (12)	3 (8)	4 (10)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Means of transportation to and from workplace					
Private transport	127 (95)	21 (95)	48 (96)	58 (96)	0.90
Public transport	3 (3)	1 (5)	1 (2)	1 (2)	
Walk	2 (2)	0 (0)	1 (2)	1 (2)	
Daily working hours					
5-<6	51 (38)	9 (41)	23 (46)	19 (32)	0.08
6-7	67 (51)	11 (50)	26 (52)	30 (50)	
>7	14 (11)	2 (9)	1 (2)	11 (18)	
Daily movements between offices at workplace					
Yes	93 (70)	14 (63)	36 (72)	43 (72)	0.74
No	39 (30)	8 (37)	14 (28)	17 (28)	
Use of elevator at workplace					
Always	82 (62)	12 (54)	33 (66)	37 (61)	0.81
Never	11 (8)	3 (14)	4 (8)	4 (7)	
Sometimes	39 (30)	7 (32)	13 (26)	19 (32)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Daily time spent using computer					
≤0.5 hour	50 (38)	4 (18)	16 (32)	30 (50)	0.06
0.5-1 hour	33 (25)	9 (41)	13 (26)	11 (18)	
>1 hours	49 (37)	9 (41)	21 (42)	19 (32)	
Daily time spent watching television/ smart device (*eg*, mobile phone/iPad)					
≤0.5 hour	8 (6)	1 (4)	4 (8)	3 (5)	0.46
0.5-1 hour	22 (17)	1 (4)	10 (20)	11 (18)	
>1 hours	102 (77)	20 (92)	36 (72)	46 (77)	
Daily hours of sleep					
5->6	81 (61)	11 (50)	32 (64)	38 (63)	0.64
6-7	42 (32)	10 (45)	15 (30)	17 (28)	
>7	9 (7)	1 (5)	3 (6)	5 (9)	

Table 1 (cont)

Demographic characteristic	Frequency, *n* (%)				*p*-value[b]
	Average (N = 132)	Normal weight[a] (N = 22)	Overweight[a] (N = 50)	Obese[a] (N = 60)	
Housework helper					
Yes	69 (52)	9 (41)	27 (54)	33 (55)	0.50
No	63 (48)	13 (59)	23 (46)	27 (45)	

[a]Normal weight: BMI = 18.5-24.9 kg/m^2; overweight: BMI = 25.0-29.9 kg/m^2; obesity: BMI >30.0 kg/m^2

[b]Significantly different when *p*-value ≤0.05 (Comparison between all variables with groups according to body mass index (BMI)) using Chi-square test

[c]Consists of 16 normal weight, 36 overweight and 40 obese

BMI: body mass index; kg/m^2: kilograms per square meter; SAR: Saudi Riyal (1 SAR = 0.27 United States dollar)

for 62% (Table 1). Nearly all (95%) of the office employees had private transport to and from the workplace, where 51% worked 6-7 hours a day and 11% >7 hours per day (Table 1). Work for 63% of employees required the use of a computer for ≤1 hour, and involved moving between offices for the majority (70%). The vast majority (92%) used (always or sometimes) office escalators. At home, 77% of the participants watched television and/or smart devices, almost all (93%) slept 5-7 hours per night, and a little over half (52%) had a helper with the housework (Table 1).

There are no significant differences among the three weight categories for any of the aforementioned properties.

Body physical parameters

The female office employee participating in the study, on average, was 38.8 ± 0.4 years old, weighed 74 ± 1.2 kg, was 1.58 ± 0.01 m tall, had a waist circumference of 84.9 ± 0.9 cm, and was considered borderline between overweight and obese (BMI of 29.8 ± 0.5 kg/m^2) (Table 2). Participants had an average metabolic rate of 1,476 ± 12 calories, a percent body fat of 36.5 ± 0.6, and a body muscle and water mass of 46.3 ± 0.5 and 33.9 ± 0.4 kg respectively. There are significant differences among the three weight groups for all parameters, the values of which increased from the normal weight to the obese group. However, there is only a significant difference between the obese group and the other two weight groups; also, there are no significant differences in height among the three weight groups.

Relationship between average weight and surveyed parameters

Among the 22 parameters collected in the study (Table 3), significant positive associations were observed between the participant's average weight and obesity in family, number of children, type of main meal, type of neglected meal, and daily office working hours. On the other hand, significant inverse associations were noted between the

Table 2

Body physical parameters of female office employees, Qassim University, Saudi Arabia

Parameter	Mean ± standard error				*p*-value[b]
	Average value (*n* = 132)	Normal weight[a] (*n* = 22)	Overweight[a] (*n* = 50)	Obese[a] (*n* = 60)	
Age (years)	38.8 ± 0.4	37.5 ± 1.13	37.8 ± 0.6[c]	40.3 ± 0.7[c]	0.01
Height (m)	1.58 ± 0.01	158.5 ± 1.2	158.2 ± 0.8	156.7 ± 0.8	0.27
Weight (kg)	74.0 ± 1.2	57.2 ± 1.4[c]	68.3 ± 0.8[c]	85.1 ± 1.5[c]	<0.001
BMI (kg/m^2)	29.8 ± 0.5	22.7 ± 0.4[c]	27.2 ± 0.2[c]	34.6 ± 0.5[c]	<0.001
Metabolic rate (calories/ day)	1,476 ± 12	1,322 ± 16[c]	1,427 ± 10[c]	1,574 ± 16[c]	<0.001
Percent body fat mass	36.5 ± 0.6	27.8 ± 1.0[c]	35.1 ± 0.5[c]	40.9 ± 0.7[c]	<0.001
Body fat mass (kg)	27.8 ± 0.8	16.1 ± 0.9[c]	24.1 ± 0.6[c]	35.2 ± 1.1[c]	<0.001
Body muscle mass (kg)	46.3 ± 0.5	41.0 ± 0.5[c]	44.2 ± 0.4[c]	49.9 ± 0.8[c]	<0.001
Body water mass (kg)	33.9 ± 0.4	30.0 ± 0.4[c]	32.3 ± 0.3[c]	36.5 ± 0.6[c]	<0.001
Waist circumference (cm)	84.9 ± 0.9	71.4 ± 0.9[c]	80.8 ± 0.7[c]	93.3 ± 1.1[c]	<0.001

[a]Normal weight: BMI = 18.5-24.9 kg/m^2; overweight: BMI = 25.0-29.9 kg/m^2; obese: BMI >30.0 kg/m^2

[b]Significantly different when *p*-value ≤0.05, using one-way ANOVA test, comparing among all three weight groups

[c]Significant difference between the weight groups

ANOVA: analysis of variance; BMI: body mass index; cm: centimeter; kg: kilogram; kg/m^2: kilograms per square meter; m: meter

Table 3

Relationship of variables with average weight of female office employees, Qassim University, Saudi Arabia

Variable	Average weight	
	r[a]	*p*-value[b]
Age	0.10	0.26
Marital status	0.06	-0.52
Number of children	0.19	0.03
Education level	0.26	-0.00
Average monthly income	0.22	-0.01
Chronic disease in family	0.09	-0.33
Obesity present in family	0.31	-0.00
Daily number of meals	0.07	0.41
Preferred cooking method	0.05	0.55
Type of main meal	0.78	0.03
Most neglected meal	0.27	0.00
Drinking sugary juice	0.01	-0.90
Eating midnight snack	0.12	-0.84
Eating while watching television/smart devices	0.01	0.90
Taking daily exercise (*eg,* aerobics, swimming, walking)	0.60	0.50
Daily frequency of exercise	0.08	-0.35
Means of transportation to and from workplace	0.07	-0.40
Daily office working hours	0.19	0.03
Daily requirement of movement between offices	0.03	-0.76
Using office elevator	0.10	-0.27
Daily number of hours using computer	0.17	-0.05
Daily number of hours sleeping	0.03	-0.70

[a]Pearson correlation coefficient

[b]Statistically significant when *p*-value ≤0.05 using the simple linear correlation test

participants' average weight and education level, average monthly income, and daily number of hours using a computer. Overall, these findings highlight the importance of addressing the factors related to overweight/obesity among female office employees.

Daily food intake

A 24-hour food intake of female office employees was determined by personal interviews conducted by members of the research team and reported in terms of daily average energy, macronutrients, vitamins, and essential elements (Table 4). Intake of energy was 1,190 ± 75 calories, protein 36.9 ± 2.3 g, carbohydrate 169 ± 9 g, and total fiber 13.8 ± 0.8 g. Sugar intake of 68 ± 4.6 g and fat intake of 43.1 ± 4.2 g constituted 24.8 ± 15.9 and 29.4 ± 1.1 % of total calories, respectively. Intake of monounsaturated fat was 14.2 ± 1.3 g and polyunsaturated fat 11.2 ± 1.7 g. Fat-soluble vitamins, A, D and E, intake was 705 ± 60.6 µg, 24 ± 0.06 IU and 2.5 ± 0.2 mg, respectively. The vitamin B complex, B1, B2, B3, B6, Pantothenic acid(B5) and folate(B9) intake was 0.8 ± 0.0, 1.1 ± 0.0, 11.9 ± 0.7, 0.8 ± 0.1, 3.5 ± 0.2 mg/day and 219 ± 12 µg/ day, respectively. The intake of minerals has been measured in this study, such as the mean average intake of calcium(375.1 ± 27 mg/day), copper (0.9 ± 0.1 mg/day), iron (7.9 ± 0.5 mg/day), magnesium (169 ± 9 mg/day), manganese (2.2 ± 0.1 mg/day), phosphorus (590 ± 31 mg/day), potassium (1620 ± 103 mg/day), selenium(55.3 ± 4.1 µg/day), sodium(1523.1 ± 179 mg/day), and zinc(3.9 ± 0.2 mg/day) for all participants and each group of BMI classification. No significant difference was found between BMI classifications.

Outcome of nutritional health education lecture

The second questionnaire was sent one month after attending the nutritional health education lecture to assess the outcome of the lecture attendance. The female office employees reported that 87% had some background in nutrition

Table 4

Demographic characteristics, health history, dietary habit, and physical activity of female office employees, Qassim University, Saudi Arabia

24-hour intake	Mean ± standard error				*p*-value[b]
	Average value (n = 132)	Normal weight[a] (n = 22)	Overweight[a] (n = 50)	Obese[a] (n = 60)	
Energy (kcal)	1,190 ± 75	1,171 ± 94	1,130 ± 106	1,246 ± 135	0.77
Protein (g)	36.9 ± 2.3	36.0 ± 3.6	33.9 ± 3.2	39.8 ± 4.0	0.49
Carbohydrates (g)	169 ± 9	160 ± 9	168 ± 15	174 ± 15	0.86
Total fiber (g)	13.8 ± 0.8	12.5 ± 1.0	13.0 ± 1.3	14.9 ± 1.4	0.48
Sugar (g)	68.0 ± 4.6	55.8 ± 6.6	71.1 ± 7.9	69.9 ± 7.3	0.50
Percent sugar of total food intake	24.8 ± 15.9	20.8 ± 12.3	26.4 ± 15.2	24.9 ± 17.6	
Fat (g)	43.1 ± 4.2	46.3 ± 6.7	38.7 ± 5.4	45.6 ± 7.7	0.71
Percent fat of total food intake	29.4 ± 1.1	32.6 ± 2.3	29.2 ± 1.8	29.1 ± 1.8	
Saturated fat (g)					
13.2 ± 1.2	15.7 ± 1.8	14.0 ± 2.2	14.7 ± 1.9	0.95	
Percent saturated fat of total fat intake	10.0 ± 0.4	12.1 ± 1.1	11.2 ± 0.8	10.6 ± 0.6	
Monounsaturated fat (g)	14.2 ± 1.3	17.7 ± 2.3	13.9 ± 1.8	17.2 ± 2.4	0.66
Percent monosaturated fat of total fat intake	10.7 ± 0.4	13.6 ± 0.9	11.1 ± 0.6	12.4 ± 0.7	

Table 4 (cont)

24-hour intake	Mean ± standard error				*p*-value[b]
	Average value (*n* = 132)	Normal weight[a] (*n* = 22)	Overweight[a] (*n* = 50)	Obese[a] (*n* = 60)	
Polyunsaturated fat (g)	11.0 ± 1.7	13.0 ± 2.8	10.7 ± 1.6	13.6 ± 3.3	0.77
Percent polyunsaturated fat of total fat intake	8.3 ± 0.5	10.0 ± 1.1	8.5 ± 0.8	9.8 ± 0.8	
Vitamin A (IU)	2,350 ± 202	3,090 ± 539	2,073 ± 298	2,310 ± 308	0.23
Vitamin A (μg)	705 ± 60.6	927 ± 161.7	622 ± 89.4	693 ± 92.4	
Vitamin B1 (mg)	0.8 ± 0.0	0.8 ± 0.1	0.70 ± 0.1	0.8 ± 0.1	0.76
Vitamin B2 (mg)	1.1 ± 0.0	1.1 ± 0.1	1.0 ± 0.1	1.1 ± 0.1	0.74
Vitamin B3 (mg)	11.9 ± 0.7	12.4 ±1.7	11.0 ± 1.1	12.5 ± 1.2	0.61
Vitamin B6 (mg)	0.8 ± 0.1	0.9 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.50
Vitamin B12 (μg)	1.1 ± 0.1	0.9 ± 0.2	1.0 ± 0.1	1.2 ± 0.3	0.76
Vitamin C (mg)	29.0 ± 4.8	23.5 ± 7.5	28.6 ± 7.6	31.4 ± 8.0	0.85
Vitamin D (IU)	24 ± 0.06	20 ± 0.12	24 ± 0.06	28 ± 0.12	0.66
Vitamin D (μg)	0.6 ± 0.1	0.5 ± 0.2	0.6 ± 0.1	0.7 ± 0.2	
Vitamin E (mg)	2.5 ± 0.2	2.0 ± 0.5	2.1 ± 0.3	3.1 ± 0.4	0.14
Folate (μg)	219 ± 12	186 ± 16	205 ± 19	222 ±19	0.53
Pantothenic acid (mg)	3.5 ± 0.2	3.3 ± 0.3	3.4 ± 0.3	3.7 ± 0.4	0.80
Calcium (mg)	375 ± 27	339 ± 37	393 ± 36	374 ± 48	0.80

Table 4 (cont)

24-hour intake	Mean ± standard error				*p*-value[b]
	Average value (*n* = 132)	Normal weight[a] (*n* = 22)	Overweight[a] (*n* = 50)	Obese[a] (*n* = 60)	
Copper (mg)	0.9 ± 0.1	0.7 ± 0.1	0.9 ± 0.1	0.9 ± 0.1	0.48
Iron (mg)	7.9 ± 0.5	7.4 ± 0.6	7.5 ± 0.7	8.5 ± 0.8	0.52
Magnesium (mg)					
169 ± 9	154 ± 10	165 ± 14	178 ± 15	0.61	
Manganese (mg)	2.2 ± 0.1	1.9 ± 0.2	2.2 ± 0.2	2.3 ± 0.2	0.63
Phosphorous (mg)	590 ± 31	575 ± 45	570 ± 42	611 ± 58	0.82
Potassium (mg)	1,620 ± 103	1,563 ±127	1540 ± 131	1,709 ± 193	0.74
Selenium (µg)	55.3 ± 4.1	45.8 ± 6.0	52.0 ± 5.5	61.5 ± 7.3	0.33
Sodium (mg)	1,523 ± 179	1,385 ± 165	1,237 ± 118	1,812 ± 375	0.33
Zinc (mg)	3.9 ± 0.2	3.5 ± 0.4	3.7 ± 0.3	4.2 ± 0.4	0.42

[a]Normal weight: BMI = 18.5-24.9 kg/m^2; overweight: BMI = 25.0-29.9 kg/m^2; obesity: BMI >30.0 kg/m^2

[b]Significantly different when *p*-value ≤0.05; comparison between groups according to body mass index (BMI) in terms of average intake of vitamins and minerals in a 24-hour meal using one-way ANOVA test

ANOVA: analysis of variance; BMI: body mass index; g: gram; IU: International Unit; kcal: kilocalorie; kg/m^2: kilograms per square meter; mg: milligram; µg: microgram

knowledge, but 95% wished to learn more about basic healthy nutrition. Most (84%) attended the lecture in person, and 56% reported benefiting significantly from the knowledge received. Half of the participants reported improved eating habits, focusing on moderating their calorie intake. There was a strong belief expressed by 97% of the participants in the health benefits of physical activity, with 70% keen on participating in one kind or another of physical exercise. The majority (74%) were aware of the Saudi Arabia Ministry of Health exercise activity recommendations.

As regards eating habits, 57% of the respondents still neglected breakfast. Only 39% correctly identified carbohydrates, protein and fats as the main sources of macronutrients. Improved consumption of vegetables and fruits was reported by 59%, along with increased daily consumption of fish and meat. Reduced intake of sweetened juice and soft drinks was reported by 78% and 91% respectively. Nuts were correctly identified as key fat sources. Half of the participants reported reduced fast-food consumption, particularly among those with obesity.

Awareness of vitamins and essential chemical elements increased, with 93% of the participants correctly identifying common sources of vitamin C and 70% accurately recognizing that a BMI of 20 kg/m^2 is that of normal weight. Overall, the nutritional health education lecture fostered significant positive changes in nutrition knowledge and eating habits among the female office employees.

The questionnaire also investigated the participants' body physical measurements post-lecture. On average, there is a significant decrease in waist circumference (p-value <0.001) but there are significant increases in total body water mass (p-value = 0.05), body fat mass (p-value = 0.01) and percent body fat mass

(p-value <0.001) (Fig 1A); however, there are no significant changes in weight, BMI and body muscle mass. In the normal weight group, there are significant increases in weight (p-value = 0.02), BMI (p-value = 0.02) and body fat mass (p-value = 0.03), but no changes in the other parameters (Fig 1B). In the overweight group, there are significant increases in body fat mass (p-value = 0.01) and percent body fat mass (p-value = 0.01), but no changes in the other parameters (Fig 1C). In the obese group, there is only a significant decrease in waist circumference (p-value = 0.01) and no changes in the other parameters (Fig 1D). These changes in measurements may indicate that overweight and obese female employees are trying to reduce their weight to a healthy weight; however, the short time between the first measurement and the second measurement may not be enough to have significant changes. Results indicate that the obese group benefited most from the educational lecture.

DISCUSSION

The study analyzed the demographic characteristics (health history, dietary habits and lifestyle), body physical parameters, and daily food intake of female office employees at Qassim University. The participants were divided according to BMI values into three weight groups: normal (17%), overweight (38%) and obese (45%). In addition, participants attended a lecture on nutritional health education, and the outcome of knowledge gained from the lecture was assessed after one month.

The results revealed that the majority of married office employees were in the overweight/obese group, in contrast to a previous report from Korea, which found that the highest risk of obesity was among those with greater socioeconomic vulnerability (Park and Ko, 2021). Obesity may be linked to the number of children, as women's nutritional needs change with multiparity (Akgun *et al*, 2017). The highest percent

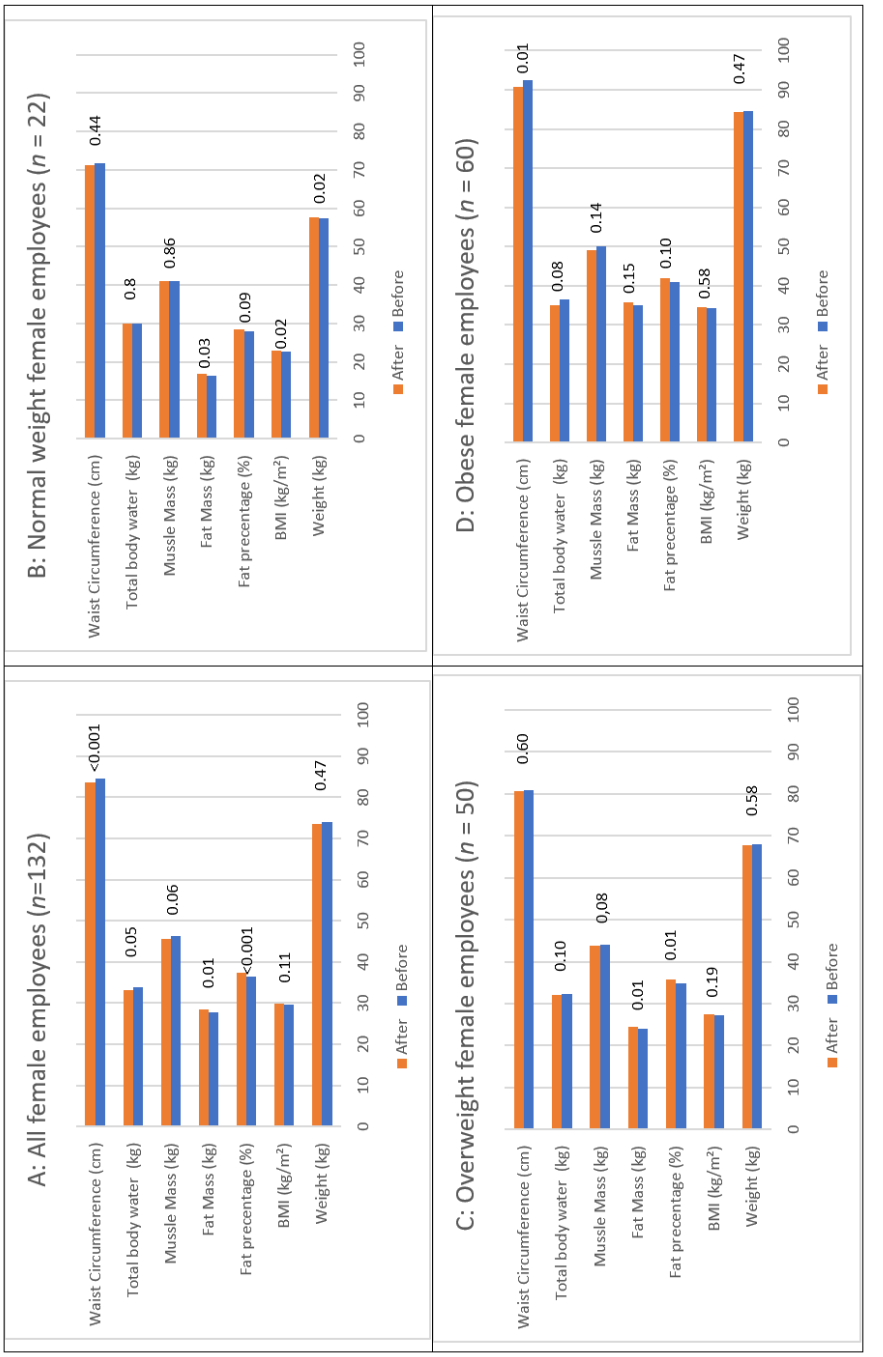

Fig 1 - Body measurements of female office employees, Qassim University, Saudi Arabia before and after attending educational lecture

Notre: Number to the right of each pair of horizontal bars represents p-value, which indicates significant difference when ≤0.05, using paired t-test. X-axis shows the mean value of measurement.

BMI: body mass index; cm: centimeter; kg: kilogram; kg/m^2: kilograms per square meter

female employees with a bachelor's degree were of normal weight, while the highest percent women with secondary education were in the overweight/obese group. The highest percent office employees in the normal weight group were those in the highest monthly income bracket (>USD1866), in contrast to a previous study, which reported that for obesity, there was a small positive association: higher minimum wage was linked to a slight increase in obesity (Conklin *et al*, 2018).

The current study found no association between BMI and chronic disease among female office employees and their families. However, those in the obese group have a higher percent obesity in the family than in the other two weight groups. Parental characteristics, particularly maternal weight, influence an offspring's metabolism (Scheidl *et al*, 2023).

No significant disparities were noted in dietary habit and BMI among the participants. A considerable proportion (43%) of the participants neglected breakfast, a behavior shown to correlate with obesity (Lemamsha *et al*, 2022); however, in the current study, the lowest percent participants skipping breakfast was in the obese group. Only 25% of the participants drank sugary juices, a proportion that remained constant across all three weight groups. Nevertheless, it is worth noting that in general there exists a link between poor dietary habits, obesity and health risk (Lemamsha *et al*, 2022).

Some 70% of female office employees regularly (1-2 times a week) engaged in physical exercise, albeit for less than two hours per session, indicating their commitment to maintaining a healthy condition. Boyce *et al* (2008) reported a correlation between vigorous physical activity and prevention of weight gain, especially among individuals employed in sedentary or desk-bound jobs. Awosan *et al* (2017) attributed a sedentary job at work to overweight/obesity. Çakir *et al* (2020) noted that obese

female employees tend to work longer hours. However, these phenomena were not observed in the current study that showed 50% of participants in all three weight groups worked 6-7 hours per day, with 70% moving between offices and 60% using elevators to go between floors. Computer use of more than one hour was comparable between normal and overweight office employees, but lower in the obese group. Kim *et al* (2019) reported no strong association between computer use and obesity among adults in the United States.

Adults are advised to sleep daily for 7-8 hours (Chaput *et al*, 2020). Approximately half of the participants in all three weight groups slept less than six hours per day. However, Çakir *et al* (2020) reported that lack of sleep may be a cause of obesity. Half of female office employees in all three weight groups relied on assistance with housework. On the other hand, Cleland *et al* (2008) found that having a helper at home leads to decreased mobility and an association with obesity.

The study indicates that female employees have lower average energy and protein intake compared to the recommended values (Jiang *et al*, 2021), with protein intake at 36.9 g/day, which is below the RDA of 46 g/day (Simonson *et al*, 2020). Conversely, carbohydrate intake exceeds the RDA of 130 g/day, contributing to a high prevalence of obesity (45%) and overweight (38%). The current study revealed that daily intake of the macronutrients, protein and carbohydrate by female office employees in all three weight groups met the AMDR guidelines (USDA and HHS, 2015), except for unsaturated fat that was below the accepted range.

Fiber intake was deficient across all BMI classifications. Fiber may help control and reduce weight (Namazi *et al*, 2017). Ntrigiou *et al* (2018) indicated that daily consumption of food rich in fiber is associated with a lower BMI.

Daily sugar intake was high, but not significantly different among the

three weight groups. Livingstone *et al* (2022) reported that high sugar intake from sweetened beverages correlates with obesity. As shown by the results of the current study, overweight/obesity among the participants could be associated with low consumption of total fiber and high intake of sugar. As Qassim University is located in one of the date-producing regions (Al-Qassim) in Saudi Arabia, eating dates with coffee is considered a normal habit, which increases carbohydrate intake.

Fat intake is within the AMDR guidelines, with saturated fat slightly above the DGA recommendation (USDA and HHS, 2015), which state that the intake of saturated fats should not exceed 10% of the total calories, as the study of Graff *et al* (2017) who concluded that decrease in the intake of saturated fats is associated with improved cardiovascular function in women with polycystic ovaries, where polycystic ovaries are associated with body mass index (Venkatesh *et al*, 2022). AMDR recommended that the intake of monounsaturated and polyunsaturated fats be (6-11% and 15-20%), respectively, of the total calories (USDA and HHS, 2015).

Daily vitamins B3, B6, B12, B9, B5 and C consumption were below RDA recommended levels (USDA and HHS, 2015), with vitamin C intake slightly lower in the normal weight group compared with those in the higher weight categories. Carr *et al* (2022) determined that there is a greater need for vitamin C with increasing weight. According to a previous study by Köse *et al* (2019), individuals with a higher body mass index have less use of dietary supplements and thus may have a lower folic acid (folate) level. Also, taking dietary supplements (pantothenic acid) can reduce accumulated fat content, meaning it helps in weight loss, as mentioned in the study by Qian *et al* (2022). Daily vitamin D intake (24 IU) was insufficient; the normal RDA is 400 IU/day (USDA and HHS, 2015), which agrees with the results of the study conducted in Iraq (Jawad and Baiee, 2020), which indicated

that the study participants who overweight or obese suffered from vitamin D levels were low.

Most of the daily intake of essential chemical elements, including calcium and iron, was below RDA recommendations, which agrees with Lu *et al* (2021), who stated that there is an inverse relationship between calcium intake and the occurrence of obesity. In regard to the level of iron which was below the RDA recommendation, we find that the deficiency decreases with weight gain, similar to the study's results (Ferreira *et al*, 2022), which indicated a correlation between high iron intake and obesity. However, there is an increase in manganese intake, where the average intake for female employees was 2.2 mg/day. There was a slight increase in the intake with an increase in body weight, as the study (Venkatesh *et al*, 2022) confirms the effect of body mass index on most reproductive disorders in women, such as menopause and polycystic ovaries. A previous study indicates a relationship between an increase in the level of manganese in the blood and an increase in prolactin in women with polycystic ovaries (Solovyova *et al*, 2019). In general, there is a deficiency in the intake of essential minerals compared to the recommendations, and this is consistent with Ferreira *et al* (2022), who noted that the deficiency of essential chemical elements decreases with weight gain. No significant difference was found between BMI classifications for the daily intake of essential minerals.

As aforementioned, participants were assessed on the outcome of attending a lecture on nutritional health education. A high proportion (84%) of participants attended the lecture, with 56% reporting improvement in their eating habits. Despite maintaining some poor habits, such as neglecting breakfast, half of the participants became more aware of the need to reduce their caloric intake, which is crucial for maintaining good health (Aljadani and Alobodi, 2018). A majority (70%) showed increased

interest in physical activity. Enhancing nutritional awareness, especially among overweight/obese individuals, is crucial, if they wish to lose weight.

To obtain an objective output from the implementation of the information learnt, participants' body physical measurements were taken before and after one month of attending the lecture. The overall results were mixed: while there was a decrease in waist circumference, there were increases in body fat mass, percent body fat mass and total body water mass, while other parameters, *eg*, weight, remained unchanged. Ugras (2020) indicated that excessive water intake leads to increased body fat mass and percentage. The short interval between the first and second anthropometric measurements is a limitation of this type of study, as it does not allow sufficient time to detect any changes. Also, the different behavioral responses among participants in the three weight groups and the small, unequal numbers in each weight category add confounding factors to the statistical analysis of the various measurements.

The study revealed an alarming proportion (80%) of female office employees in an academic institution were overweight/obese, raising concerns about a lack of awareness of the health risks associated with this condition. Previous studies have shown a higher prevalence (49%) of overweight and obesity (31.5%) among Saudi adult women (Al-Nozha *et al*, 2005; Alquwaidhi *et al*, 2014). More recently, Aljadani and Alobodi (2018) and Alraddadi *et al* (2019) pointed out that the prevalence of overweight and obesity among Saudis continues to be high (30.1% and 35.6%), with overweight individuals being 5.6 times more likely to suffer from chronic diseases.

In conclusion, the study of female office employees at Qassim University revealed a high prevalence of overweight and obesity, although the etiology remained elusive. The average

weight of the participants was significantly associated with the presence of obesity in the family, multiparity, lower education level, lower monthly income, type of main meal (lunch), type of meal missed (breakfast), number of daily working hours (6-7), and lower hours of office computer use (one hour or less). According to the 24-hour dietary recall survey, the consumption of sugar was high, but intake of unsaturated fat, fiber, vitamins B3, B6, C, and D, and essential chemical elements was below recommended levels. Following a lecture on nutritional health education, nearly half of the participants reported positive changes in some of their eating habits, and the majority acknowledged the need for an increase in their regular physical exercise. Measurement of body physical parameters post-lecture showed a significant decrease in average waist circumference but no change in the average BMI. These findings highlight the need for enhanced awareness and education on healthy nutrition and an appropriate lifestyle to control weight gain and prevent obesity-related health risks, not only for Saudi female office employees, but for all citizens in the Kingdom.

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CONFLICT OF INTEREST DISCLOSURE

The authors declare no conflict of interest.

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