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ORIGINAL STUDY

Structural equation model analysis for the evaluation of factors associated with overweight and obesity in menopausal women in RaNCD cohort study

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Abstract

Objective: Weight gain and increased body fat mass are among the common complications of menopause. In addition to hormonal changes, behavioral and environmental factors aggravate transition through this phase. This study uses a structural equation model (SEM) to evaluate factors associated with overweight and obesity in menopausal women.

Methods: This is a cross-sectional study of 4,471 women (pre/perimenopausal 3,150, menopausal 1,321) from baseline data of the Ravansar Non-Communicable Disease (RaNCD) cohort study in the west region of Iran in 2018. Obesity and overweight were the outcome variables. SEM was used to examine the relationships, using IBM SPSS, AMOS version 23.

Results: The mean body fat percentage and visceral fat area in menopausal women was significantly greater than among pre/perimenopause women. The direct association of higher socioeconomic status (SES) with a healthy dietary pattern was stronger among pre/perimenopausal women than among menopausal women (ß = 0.574 vs ß = 0.552). In both groups, less physical activity was associated with depression and musculoskeletal disorders, and this association was stronger in menopausal women (ß = −0.174 vs ß = −0.215; $P > 0.05$). Overweight and obesity were directly decreased (ß = −0.011, $P > 0.05$) and indirectly increased (ß = 0.013, $P > 0.05$) in pre/perimenopausal women by sleep duration, but they were directly and indirectly decreased in menopausal women.

Conclusions: The direct and indirect effects of well-known risk factors associated with overweight and obesity were found to be different in pre/perimenopausal and menopausal groups. Some risk factors showed stronger effects among menopausal women compared with the pre/perimenopausal women. Physical activity and healthy dietary pattern had a mediator impact in the two study groups.

Key Words: Menopause – Obesity – Overweight – Structural equation model.

Weight gain and increased body fat mass are among the common consequences of entering menopause. Multiple studies confirm the prevalence of weight gain and increased risk of developing diseases associated with obesity, especially cardiovascular disease and cancer, among menopausal women.[1] As a result, the prevalence of obesity and metabolic syndrome during the menopause period is three times higher than during the pre/perimenopausal period.[2] The main factors affecting body composition in menopause include genetic factors (genetic predisposition, ethnicity, and epigenetic changes), hormonal factors (relative hyperandrogenemia, rapid hypoestrogenemia, and low sex-hormone binding globulin [SHBG] levels), and external factors (low physical activity, unhealthy nutrition intake, diseases and drugs, including steroids and insulin), all of which are likely to result in increased weight, increased fat mass, and reduced fat-free mass (FFM).[1]

Apart from hypoestrogenism resulting from menopause, which has a significant role in increasing visceral fat, behavioral and environmental factors are also found to be associated with weight gain. One of the most important factors mentioned as the main cause of weight change in menopausal women is less active lifestyle during this period. Studies have reported that physical activity decreases with advancing age, which is regarded as an important factor leading to weight gain

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and obesity among middle-aged and menopausal individuals.[3-5] Researchers have found that mental disorders (especially depression due to its impact on physical activity and nutrition) are one of the main causes of overweight and obesity,[6-8]

Socioeconomic status (SES) and its relating factors including education level, employment status, and income are also correlated with overweight and obesity, albeit with different levels of impact observed in developed and developing countries.[9,10] Sleep duration is another risk factor for obesity. Sleep duration changes and often decreases during menopause due to hormonal, metabolic, and physiological changes that will lead to weight gain and fat mass in women.[11]

As different groups of the population (children, adolescents, adults, and menopausal women) are not affected by overweight and obesity to the same extent, there is a need that the issue is examined among a specific population. On the contrary, such risk factors can play different roles in the occurrence of an outcome. While the direct effect of each risk factor is crucial, mediation is another method through which such factors may affect obesity and overweight.

The present study uses the structural equation model (SEM) to determine the direct and indirect effect of different risk factors on obesity and overweight in pre/perimenopausal and menopausal women.

METHODS

Study design and participants

This is a cross-sectional study based on baseline data from Ravansar Non-Communicable Disease (RaNCD) cohort study in western Iran in 2018. It is a part of the Prospective Epidemiological Research Studies in Iran (Persian) conducted on various ethnicities of an Iranian population in coordination with the Ministry of Health and Medical Education, in which 10,000 adults were recruited for RaNCD.

The RaNCD cohort study is the first cohort study of a Kurdish population (Kurdish ethnicity inhabit Turkey, Syria, Iraq, and Iran) which is being conducted in rural and urban areas of Ravansar county located in the west of Kermanshah—a province of about 2 million people with an area of 24,434 km^2. The city of Kermanshah—the center of the province—is the largest and most important Kurdish settlement in the western region of Iran, with a population of about 1 million. Ravansar county is inhabited by 50,000 people, almost all of whom belong to the Kurdish ethnicity. There are three urban and two rural healthcare centers in the Ravansar county. Thirty-two local primary healthcare units (Health houses) also operate in rural areas of the county.

Women between 35 and 65 years of age, who were permanent inhabitants of Ravansar region (Ravansar town and all villages in its vicinity) and of Iranian nationality, were recruited in the study. Participants who met the inclusion criteria were provided with oral and written informed consent.

The study was registered (No: 97133) at the vice chancellery for research and technology, and was approved by the ethics committee of Kermanshah University of Medical Sciences (KUMS.REC.1397.092), Kermanshah, Iran.

Participants included all women from the first phase of the cohort study. Exclusion criteria for the RaNCD cohort study were; unwillingness to attend the study, living in Ravansar under 9 months in a year, being a new inhabitant (under 1 year), and being unable to attend the cohort center or to communicate with interviewers (due to mental or physical disability or any acute psychological disorder, blindness, deafness, and dumbness).

For the present study, the exclusion criteria were as follows: pregnancy, chronic diseases such as cancer and thyroid disorder, use of thyroid drugs, insulin, and diabetes drugs, use of drugs aimed at increasing or decreasing weight, hysterectomy, and hormone drugs.

Sociodemographic and economic characteristics such as age, sex, job, education, welfare, and medical information were collected, using digital questionnaires filled by a trained interviewer. In addition, information on personal habits (including cigarette smoking and alcohol consumption, dietary habits, and physical activity) were included into a digital questionnaire. Details of rational and study design have already been published.[12,13]

Definitions and measures

The Bio-Impedance Analyzer BIA (Inbody 770, Inbody Co, Seoul, Korea) was used to measure body weight with a precision of 0.5 kg. BSM 370 (Biospace Co, Seoul, Korea) was used to measure height with the precision of 0.1 cm. The body mass index (BMI) was calculated as weight (kg) divided by height squared (m). Visceral fat was measured by BIA. For abdominal obesity, waist circumference (WC) was selected as an indicator of obesity. WC was measured with a flexible measuring tape at a level midway between the lower rib margin and the iliac crest to the nearest 0.5 cm.

The outcome variables in this study—overweight and obesity—were classified as latent variables with three markers including BMI, WC, and visceral fat used quantitatively.

Dietary patterns were evaluated using a Food Frequency Questionnaire (FFQ), the validity of which was confirmed in Iran.[14] The questionnaire comprised of 10 sections including 125 food items such as bread and cereal, legumes, meat and its products, milk and dairy products, vegetables, fruits, and other (varieties of oils, fats, sugar, sweets, and salt). The standard physical activity questionnaire of PERSIAN cohort was implemented to assess participants' physical activity. The questionnaire consisted of 22 questions regarding the amount of an individual's daily activity. Based on the intensity of activity, physical activity was divided into three groups (light, moderate, vigorous).

Depression was determined based on the use of antidepressants, self-reported depression, and also a verbal confirmation from a physician. The diagnosis of musculoskeletal disorders was also made with regards to drug use and self-declaration of conditions such as walking disorders, joint pain, back pain, and leg pain. Sleep duration was measured in 24 hours by self-reporting questions: ''1. How long do you sleep at night? 2. How long do you nap?'' They were quantitatively applied,

and the values were summed. Marital status was also categorized into two groups, including married and single/widowed/divorced, with the married group being considered as the reference group.

Menopause status was defined as having no menstrual period for the past 12 months.[1,11] It was determined based on the answer to the following question: ''Have you menstruated for the past 12 consecutive months?'' If ''yes'', participants were defined as pre/perimenopausal, and if ''no'', participants were defined as menopausal.

Statistical analysis

The IBM SPSS, AMOS version 23 was used for data management and statistical analyses. Mean ± SD for continuous variables and frequency (%) distribution of categorical data were reported for participants. The Principal Component Analysis (PCA) with orthogonal varimax rotation was conducted to estimate the factor loading which influenced responses on the observed variables (food groups) and wealth.

The normality of data was checked using Kolmogorov-Smirnov test. Kaiser-Meyer-Olkin (KMO) test is a measure of how data are suitable for factor analysis. The test measures sampling adequacy for each variable in the model and for the complete model. The statistics is a measure of the proportion of variance among variables that might have a common variance.[14] The KMO index was approved for the economic welfare variable with the value of 0.738, and for the dietary pattern with a score of 0.822. The Bartlett Sphere assumption also confirmed the PCA for both variables ($P < 0.001$).

The economic welfare variable was measured using 12 questions regarding housing, car, home appliances, and other amenities by PCA method. Data from FFQ were divided into 24 food groups.

The participants were asked to report their usual intake (portion size) of each food item for the past year on a daily, weekly, monthly, and yearly basis. The portion sizes were then converted into daily intakes (g). Three dominant dietary patterns were identified among participants using PCA. These patterns are as follows: healthy dietary pattern, unhealthy dietary pattern, and mixed dietary pattern, with a factor loading above 0.30 which remained in each dietary pattern.[15]

The SEM was used to study the direct and indirect effects of risk factors on overweight and obesity. SEM is one of the main methods for analyzing the complex data structure and examining the direct and indirect relationships between a set of variables. This means analyzing various variables which show the simultaneous effects of variables together in a theory-based structure. SEM is a combination of two parts: the measurement model (confirmatory factor analysis [CFA]) and the structural model (regression analysis).[16-18]

The conceptual model of research is shown in Fig. 1. In the conceptual model, there are three latent variables including the main dependent variable, which is obesity and overweight, with the indicator of BMI; WC; and visceral fat area (VFA). Two other latent variables that play the role of independent variables in the model include SES with three indicators: economic prosperity (Wealth); education level (Edu); and place of residence (Place), and variables of chronic illness (disease), which also have two markers: depression (Dep) and musculoskeletal disorders (Sklt). Other variables in the model are obvious and include physical activity, sleep duration, healthy dietary pattern, and marital status.

Comparative fit index (CFI), incremental fit index (IFI), and normed fit index (NFI) equal to or greater than 0.90 and Root Mean Square Error of Approximation (RMSEA) equal to or less than 0.08 were applied to confirm the fit of the model. Model estimations were assessed, using Maximum Likelihood Estimation (MLE). In all analyses, the P values <0.05 were considered as significant.[18]

RESULTS

Characteristics of the sample

After applying the exclusion criteria, 4,471 women with an average age of 47.53 ± 7.99 years were studied. Overall, 3,721 (83.23%) women were married and the rest were single or divorced. About 57% (2,552 women) were city residents and the rest lived in rural areas. The mean weight in pre/perimenopausal women was 70.52 ± 12.99 kg, and in menopausal women was 66.88 ± 12.60 kg ($P < 0.001$). The mean of VFA in pre/perimenopausal women was 143.96 ± 48.07 cm^2, and in menopausal women was 147.47 ± 49.16 cm^2 ($P = 0.027$). The average sleep duration in pre/perimenopausal and menopausal women was 7.24 ± 1.21 and 6.95 ± 1.31 hours within 24 hours, respectively ($P < 0.001$) (Table 1).

Factor loading for the dietary groups in each dietary pattern is presented in Table 2. The positive/negative factor loading in each pattern indicates a direct/inverse relationship to that pattern. A higher factor loading of a dietary group in a pattern means the greater contribution of that dietary group in that pattern.

Confirmatory factor analysis

In the CFA between the latent variables in the model, correlation and fitting indexes were acceptable (IFI = 0.968, 0.968, NFI = 0.964, CFI = 0.968, RMSEA = 0.080). The correlation between obesity and chronic diseases was 0.69, with 0.57 between SES and chronic diseases, and 0.24 between obesity and SES, all of which were statistically significant ($P < 0.001$).

Structural equation model

The variables of both models A (pre/perimenopausal) and B (menopause) showed similarity, and the fitting indices were acceptable and confirmed the model fit in both models. The value of R^2 for the main dependent variable (overweight and obesity) in pre/perimenopausal women was 0.17. Therefore, R^2 indicates the percentage of variability in overweight and obesity between individuals explained by variables in the model.

However, in model B, the value of R^2 for the main dependent variable was 0.33. Therefore, the variables within

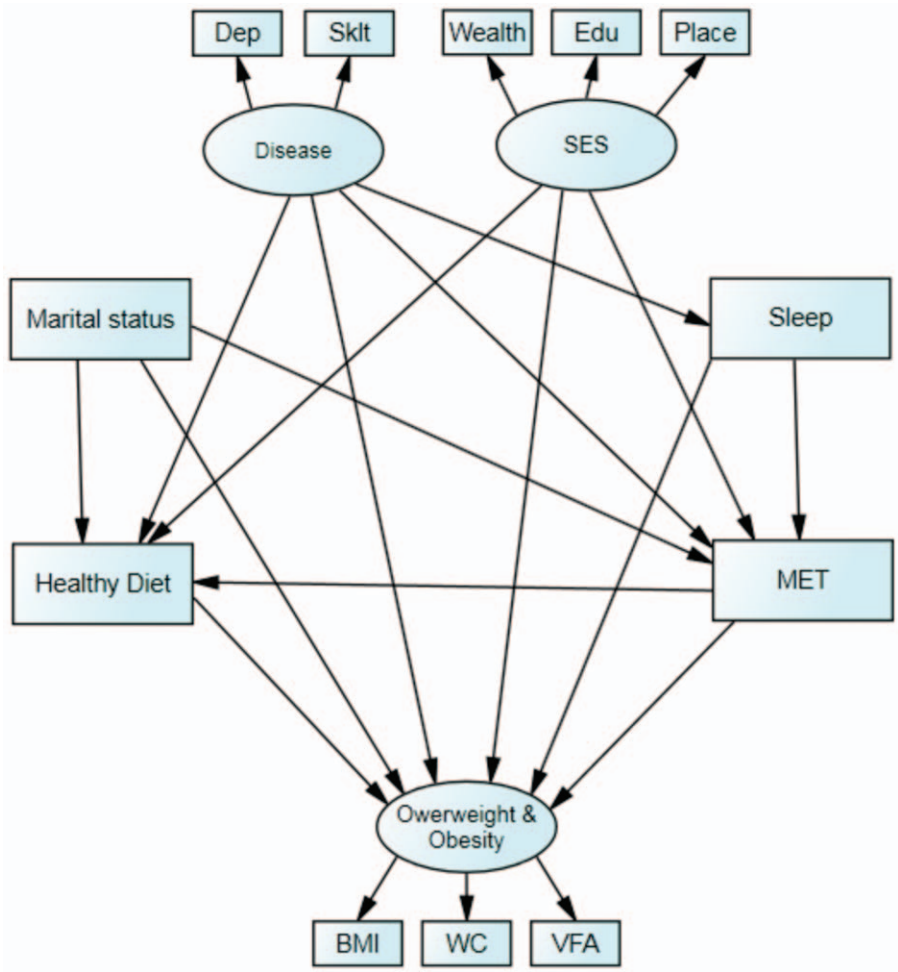

FIG. 1. A conceptual model for the association of sociodemographic, nutrition, and lifestyle with obesity and overweight. BMI, body mass index; Dep, depression; Disease, chronic disease; e, error; Edu, education-years; Marital Status, marital status; MET, physical activity; Place, city or rural; SES, socioeconomic status; Sklt, musculoskeletal disorders; Sleep, sleep duration; VFA, visceral fat area; WC, waist circumference.

the model can anticipate overweight and obesity about 33% in menopausal women (Fig. 2).

In models A and B, two variables of physical activity and healthy dietary pattern play a mediation effect. This is influenced by SES, depression, musculoskeletal disorders, marital status, and sleep duration, which then lead to overweight and obesity. These mediation variables had different effects in pre/perimenopausal and menopausal women. In model A, R^2 for both mediation variables of healthy dietary pattern and physical activity was 0.26 and 0.27, respectively. In model B, the value of R^2 was 0.29 for healthy dietary pattern and 0.13 for physical activity for the menopausal women.

Table 3 shows the direct and indirect effects of risk factors associated with overweight and obesity for the two groups. In pre/perimenopausal women, the direct effect of SES on the healthy dietary pattern was found to be greater than menopausal women (ß = 0.574 vs ß = 0.552). In pre/perimenopausal women, the direct effect of SES on overweight and obesity came out negative, but it was positive in menopausal women (ß = −0.045 vs ß = 0.185). As for depression and musculoskeletal disorders, they were correlated with reduced physical activity, which was clearer in menopausal women (ß = −0.174 vs ß = −0.215).

Depression and musculoskeletal disorders had an increased direct effect on overweight and obesity in both groups with a stronger effect in menopausal women. However, the indirect effect of depression and musculoskeletal disorders on overweight and obesity was negative in the two groups, but the association was not statistically significant.

For the indirect effect, physical activity was a mediation variable in the menopausal women. In pre/perimenopausal women, two variables of physical activity and healthy dietary pattern were mediation variables. In this group, there was an increase in 24-hour sleep duration directly (ß = −0.011) and indirectly, through physical activity (ß = 0.013), increased overweight, and obesity. However, in menopausal women, the effect was negative, with no statistically significant association.

DISCUSSION

The findings of the study showed that the direct and indirect effects of known risk factors associated with overweight and obesity was different for menopausal women. While factors

TABLE 1. *Characteristics of study participants according to menopause status*

Variables	Total (N = 4,471)	Pre/perimenopausal (n = 3,150)	Menopausal (n = 1,321)
Age (y)	47.53 ± 7.99	43.98 ± 5.74	57.72 ± 5.03
Weight (kg)	76.56 ± 13.40	70.52 ± 12.99	66.88 ± 12.60
Body mass index (kg/m^2)	26.33 ± 4.04	28.71 ± 4.88	28.04 ± 4.80
Waist circumference (cm)	96.12 ± 9.65	97.84 ± 11.27	99.01 ± 10.85
Waist-to-hip ratio	0.93 ± 0.06	0.94 ± 0.05	0.94 ± 0.06
Visceral fat area (cm^2)	96.24 ± 41.81	143.96 ± 48.07	147.47 ± 49.16
Body fat (%)	26.97 ± 6.93	39.67 ± 6.83	40.67 ± 6.98
Skeletal muscle mass (kg)	31.00 ± 4.38	22.86 ± 3.02	21.05 ± 2.89
Soft lean mass (kg)	52.30 ± 6.86	39.58 ± 4.81	36.87 ± 4.61
Fat mass index (kg/m^2)	7.33 ± 2.85	11.67 ± 3.77	11.89 ± 3.74
Calories intake (kcal)	3,863.56 ± 1,265.54	3,098.52 ± 1,105.25	2,694.69 ± 1,025.67
Sleep duration (h)	6.95 ± 1.19	7.24 ± 1.21	6.95 ± 1.31
Physical activity			
Light	977 (21.85)	640 (20.32)	337 (25.51)
Moderate	3,036 (67.89)	2,190 (69.55)	844 (63.89)
Vigorous	459 (10.26)	319 (10.13)	140 (10.40)
Place of residency			
Rural	1,919 (42.92)	1,264 (40.13)	655 (49.58)
Urban	2,552 (57.08)	1,886 (59.87)	666 (50.42)
Education level			
Illiterate	1,563 (34.96)	633 (20.10)	930 (70.40)
Primary	2,078 (46.48)	1,741 (55.27)	337 (25.51)
Secondary	697 (15.59)	650 (20.63)	47 (3.56)
Academic	133 (2.97)	126 (4.00)	7 (0.53)
Marital status			
Married	3,721 (83.23)	2,666 (84.63)	1,055 (79.86)
Single/widowed/divorced	750 (16.77)	484 (15.36)	266 (20.13)
Smoking behavior			
None	4,248 (95.01)	3,084 (97.90)	1,164 (88.12)
Current	87 (1.95)	32 (1.02)	55 (4.16)
Former	136 (3.04)	34 (1.08)	102 (7.72)
Economic status			
Class 1	1,281 (28.65)	790 (25.08)	491 (37.17)
Class 2	848 (18.97)	578 (18.35)	270 (20.44)
Class 3	733 (16.39)	578 (18.35)	155 (11.73)
Class 4	928 (20.76)	655 (20.79)	273 (20.67)
Class 5	681 (15.23)	549 (17.43)	132 (9.99)
Depression			
No	4,241 (94.86)	2,975 (94.44)	1,266 (95.84)
Yes	230 (5.14)	175 (5.56)	55 (4.16)
Musculoskeletal disorders			
No	2,039 (45.61)	1,571 (49.87)	468 (35.43)
Yes	2,432 (54.39)	1,579 (50.13)	853 (64.57)

Mean ± SD or frequency (%). SD, standard deviation.

TABLE 2. *Factor-loading matrix for three dietary patterns*

	Dietary patterns		
Food groups	Healthy	Unhealthy	Mixed
Whole grains	0.22		
Refined grains		0.20	0.20
Legumes			0.24
Fresh fruits	0.42		
Dried fruits	0.36		
Fruit juices	0.23		
Nuts	0.23		
Red meats			0.42
Processed meats			0.33
Chicken and poultry			0.23
Fish			0.29
Eggs			0.30
Saturated fats		0.33	
Unsaturated fats	0.23		
Leafy vegetables	0.31		
Other vegetables	0.35		
Dairy products	0.22		
Condiments	0.30		
Organ meats			0.45
Chicken meats			0.21
Drinks		0.52	
Salts		0.29	
Sweets and desserts		0.57	

such as depression and musculoskeletal disorders were more significant in the menopausal group, other risk factors had higher impact in pre/perimenopausal women. Among the variables included in the model, two variables of physical activity and dietary pattern were identified as a mediation variable in both groups. They were influenced by variables of SES, depression, musculoskeletal disorders, marital status, and sleep duration, leading to overweight and obesity in women.

In our study, physical activity both directly and indirectly through the healthy dietary pattern influenced the outcome. In other words, physical activity was associated with a lower proportion of overweight and obesity in pre/perimenopausal women, and with a higher proportion for the menopausal group. However, other studies have reported an inverse relationship between physical activity, and overweight and obesity.[4] Considering that our participants live in a farming area with a higher load of physical activity inherent in agriculture and horticulture, they are likely to eat heartily due to increased appetite and blood sugar decline after work.

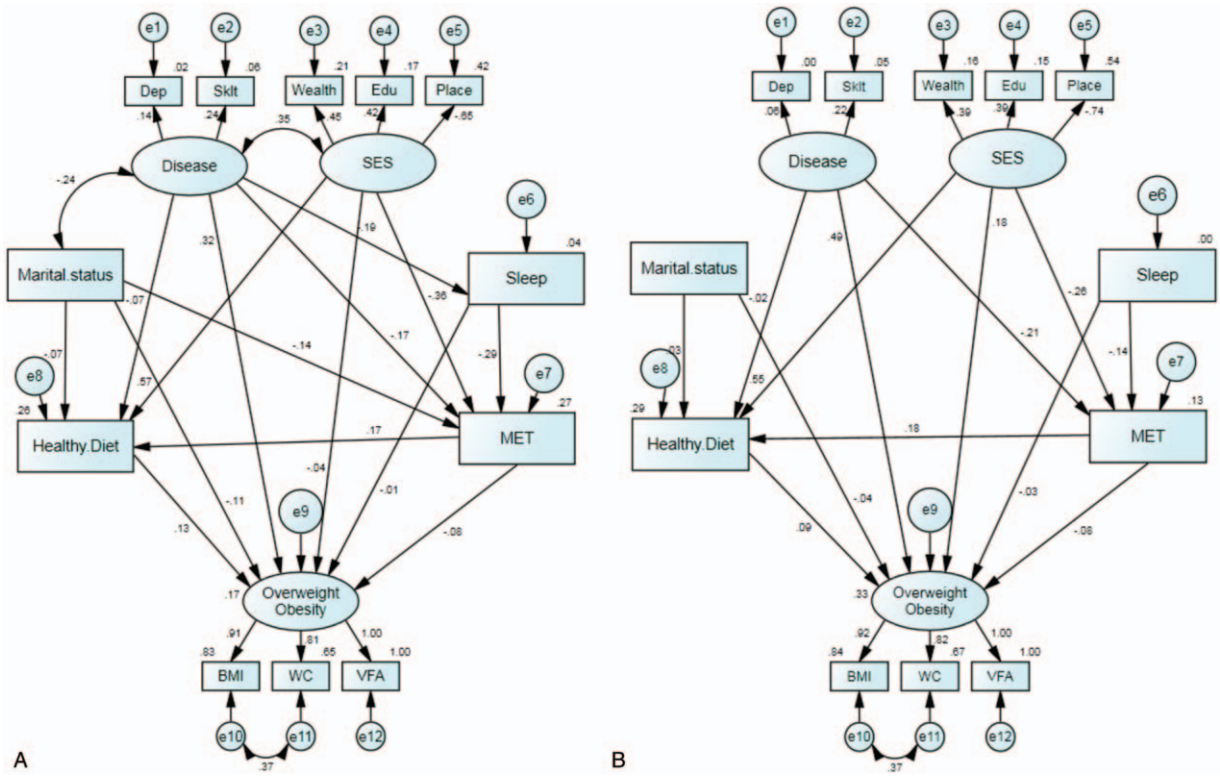

FIG. 2. Final structural models in pre/perimenopausal women (**A**) and menopause women (**B**). The standardized effects of variables are presented on pathways for women. In the model of pre/perimenopausal women: RMSEA = 0.074, NFI = 0.939, IFI = 0.937, CFI = 0.936 and in the menopausal women: RMSEA = 0.076, NFI = 0.929, IFI = 0.931, CFI = 0.931.BMI, body mass index; CFI, comparative fit index; Dep, depression; Disease, chronic disease; e, error; Edu, education-years; IFI, incremental fit index; Marital Status, marital status; MET, physical activity; NFI, normed fit index; Place, city or rural; RMSEA, Root Mean Square Error of Approximation; SES, socioeconomic status; Sklt, musculoskeletal disorders; Sleep, sleep duration; VFA, visceral fat area; WC, waist circumference.

In pre/perimenopausal women, SES had a direct negative and indirect positive effect through the healthy dietary pattern on overweight and obesity. In menopausal women, the improvement of SES was directly and indirectly (through physical activity) associated with an increase relationship on overweight and obesity. We found no study that specifically addressed SES in menopausal women. But other studies have shown that women with a more favorable SES, especially a higher education level, are more concerned about their weight gain, so they perform weight control methods more efficiently (effective physical activity and healthy dietary pattern).[19,20] Yet in this study, we found a reverse pattern in our women which could be due to lower level of knowledge regarding weight gain and its complications. Contradictorily, some

TABLE 3. *Direct, indirect, and total effect between predictors and responses in Fig 2*

		Estimate standardized coefficient					
		Pre/perimenopausal			Menopausal		
Predictor	Response	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Socioeconomic status	Healthy diet	0.574[a]	−0.051[a]	0.523[a]	0.552[a]	−0.047[a]	0.505[a]
	Physical activity	−0.360[a]	—	−0.360[a]	−0.261[a]	0.000	−0.261[a]
	Overweight and obesity	−0.045[a]	0.116[a]	0.071[a]	0.185[a]	0.044[a]	0.229[a]
Marital status	Healthy diet	−0.075[a]	−0.018	−0.093[a]	0.031	0.000	0.031
	Physical activity	−0.140[a]	—	−0.140[a]	—	—	—
	Overweight and obesity	−0.115[a]	−0.009	−0.124[a]	−0.036[a]	0.003	−0.033[a]
Physical activity	Healthy diet	0.170[a]	—	0.170[a]	0.189[a]	0.000	0.189[a]
	Overweight and obesity	−0.078[a]	0.025	−0.053[a]	0.081	0.017	0.098
Sleep duration	Physical activity	−0.295[a]	—	−0.295[a]	−0.136[a]	—	−0.136[a]
	Healthy diet	0.000	−0.041[a]	−0.041[a]	—	−0.016	−0.016
	Overweight and obesity	−0.011	0.013	0.002	−0.030	−0.002	−0.032
Chronic disease	Physical activity	−0.174[a]	0.050[a]	−0.124[a]	−0.215[a]	—	−0.215[a]
	Healthy diet	−0.075[a]	−0.012	−0.087[a]	−0.021	−0.043[a]	−0.064[a]
	Sleep Duration	−0.194[a]	—	−0.194[a]	—	—	—
	Overweight and obesity	0.325[a]	−0.011	0.314[a]	0.495[a]	−0.006	0.489[a]
Healthy diet	Overweight and obesity	0.130[a]	0.000	0.130[a]	0.091[a]	—	0.091[a]

[a]$P < 0.05$.

studies have reported a higher prevalence of obesity and weight gain in higher socioeconomic classes.[21-23] The healthy dietary pattern was associated with weight gain in both pre/perimenopausal and menopausal women, though the effect was small. This is not in agreement with healthy dietary pattern with weight loss and waist circumference,[24-26] which can be justified by the fact that although people followed healthy dietary pattern, their intake was higher than standard value, and they received more calories.

The average energy consumed by our whole population was 3865.56 kcal/d, which was higher than the recommended levels. Therefore, we conclude that even a healthy dietary pattern can lead to obesity and overweight if food intake exceeds the limit. We should also note that the relationship is assessed in a cross-sectional design, and we do not have the temporality between a healthy dietary pattern, and overweight and obesity. Some overweight or obese participants may have been subjected to a healthy diet for the purpose of weight loss.

In the context of increased prevalence of obesity and abdominal obesity, hormonal changes play an important role shortly before menopause and thereafter. Visceral fat and abdominal obesity also show a bigger increase than body weight in menopausal women.[27] Given the role of different hormones during menopause, further studies are needed to examine hormone levels before and after menopause to clarify the relationship. It should be noted that only nonhormonal factors were investigated in menopause women in our study.

The present study had both limitations and strengths. First, obesity and overweight are multifactorial disorders, and the role of genetics is mentioned as nearly 70% in other studies.[28] Included variables in the current study could anticipate about 33% and 17% of variability of overweight and obesity in menopausal and pre/perimenopausal women, respectively. This survey is based on the population of a city in the western part of Iran, which is a Kurdish settlement and may not be extended to the whole population of Iran. Regarding the SEM method, it is one of the best ways of showing the mechanism of action of different risk factors (eg, effect of physical activity on overweight and obesity). Our conceptual models for the data do not mean that they are the best models or unique, there may be other suitable models for the same dataset.

However, our sample was large enough to show all possible differences among subgroups, using all important variables. It was also the first study in Iran that targeted the Kurdish ethnicity and may be used as a reference for future studies on other ethnicities because it will allow a comparison across them.

CONCLUSIONS

The findings of this study indicated that the direct and indirect effects of known risk factors associated with overweight and obesity are different in pre/perimenopausal and menopausal women. Some risk factors in menopausal women have stronger effects compared with pre/perimenopausal group. In addition, SES has a contradictorily direct effect on overweight and obesity in pre/perimenopausal and menopausal women, which must be further explored in future investigations.

Among the variables included in the model, two variables of physical activity and dietary pattern were identified as the mediation variable for both groups and were influenced by variables of SES, depression, musculoskeletal disorders, marital status, and sleep duration, leading to obesity and overweight.

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