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Original Article

Dietary Patterns and Their Associations with General and Abdominal Obesity Among Adults in Gonabad in 2019: A Cross-Sectional Study

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ABSTRACT

Background and Objectives: Obesity is serious and most important underlying risk factor on incidence of non-communicable diseases (NCDs). In the last two decades, obesity has been on an increasing trend globally and across all age groups. Using dietary pattern analysis method could provide more information about nutritional etiology of chronic disease such as obesity. The aim of this study is to determine the association between major dietary patterns and general and central obesity among adults in Gonabad in 2019.

Materials and Methods: This cross-sectional study included 250 individuals aged 18-70 years living in Gonabad, Iran. Participants were selected by a multi-stage sampling method. The dietary intake of participants during the past year was evaluated using the semi-quantitative Food Frequency Questionnaire (FFQ), which included 168 foods items. Factor analysis was used for identifying major dietary patterns. The relationship between major dietary patterns and general and abdominal obesity was assessed by chi-square test. All data were analyzed by SPSS 14 at significance level of $P<0.05$.

Results: Participants ages ranged between 18 and 70 years old, of whom 44.8% were male and 82.4% were married. Two healthy and unhealthy dietary patterns were identified. There was no significant relationship between unhealthy diet and height ($p=0.82$) and waist circumference ($p=0.32$) variables, but this dietary pattern was correlated with body weight ($p=0.003$), hip circumference ($p< 0.001$) and body mass index ($p< 0.001$). Also, there were significant relationship between healthy dietary pattern and height ($p<0.001$), weight ($p<0.001$), waist circumference ($p<0.001$), hip circumference ($p<0.001$) and body mass index ($p=0.001$).The unhealthy diet was significantly associated with general obesity ($p <0.001$) and abdominal obesity ($p=0.01$). Both general and abdominal obesity measures were significantly associated with Healthy dietary pattern ($p = 0.003$ and $p <0.001$ respectively).

Conclusions: Major dietary patterns were significantly associated with general and abdominal obesity among adults in Gonabad. Further studies with future prospective studies, are required to confirm these findings.

Keywords: Dietary patterns, Obesity, Adults, Gonabad, Iran

Introduction

Global evidence indicates that overweight and obesity are two of the main public health problems in all age groups in the population. The World Health Organization (WHO) report states that over the past four decades, the prevalence of overweight and obesity has increased dramatically in the general population. In 2016, 39 and 13% of adults in the world were overweight and obese, respectively(1).

The prevalence of obesity and central adiposity (enlarged waist circumference) has risen steeply in Iran, particularly among women, and is becoming a public health issue. The prevalence of obesity and overweight/obesity among Iranian adults is, 22.7% and 59.3% respectively. There is a significant difference between the prevalence of obesity among males 15.3% and females 29.8%(2).

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Obesity is due to a number of factors including genetics, metabolic, socioeconomic status, environmental and behavioral factors (3). The underlying link between overweight, obesity and many chronic diseases such as cardiovascular disease, diabetes, rheumatoid arthritis, hypertension, physical inability and respiratory illness have strengthened the importance of these public health issues (1, 4, 5).

Diet is a component of lifestyle, which plays an important role in developing overweight and obesity (6, 7).Recently, the analysis of dietary pattern as an approach to study the links between food and disease was recommended. (8, 9).

In this approach, statistical methods are used to combine several foods or nutrients in order to derive single-exposure variables, or dietary patterns(10). It has been suggested that such dietary patterns could provide a better and more general overview of relation between diet and disease. (11) and perhaps more predictive of chronic disease risk than the intake of individual nutrients or foods(10).

Several studies have reported the association of the major dietary patterns with general and central obesity (12-18).

Also high prevalence of obesity in Iran and is associated with an elevated risk of several major non-communicable diseases(19), and knowing that food patterns are vary in different cultures, races, genders and geographical areas (20) and based on the fact that there has been no study of nutritional patterns in Gonabad so far, this study aims to determine the major dietary patterns and their relationship with obesity in adults people in Gonabad in 2019.

Given the high prevalence of non-communicable diseases related to nutrition, and also considering that dietary patterns in different cultures, races, sex and geographical regions are different, and since no studies have been conducted on dietary patterns in Gonabad City, this study aimed to determine dietary patterns and their relationship with obesity in adults.

Materials and Methods

This study was a cross-sectional analytical study. The study population consisted of male and female adults living in Gonabad in 2019. This research was reviewed and approved by the Ethics Committee in Gonabad University of Medical Sciences (ethical code: IR.GMU.REC.1397.060 and proposal cod: p/1/477). For the factor analysis, 24 food groups of dominant dietary patterns were studied based on Table1. For each varible least 10 people were needed(21, 22), so the sample size was set at 240 individuals. To account for the 10% dropout, the final sample size was set at 264. The Samples were selected using multistage random sampling, using a combination of simple, systematic and random cluster sampling methods. The sampling method was tested on patient who referred to Gonabad health centers. Then based on the number of populations covered by that center, the required sample size was calculated and several clusters were selected. In each zone, based on the systematic sampling of each family, one eligible person in a family was randomly interviewed, and completed the questionnaires. Inclusion criteria were aged between 18 and 70 years, gonabad resident for at least 5 years., stable physiological and psychological status and farsi literate to answer questions. pregnant or breast-feeding women, people with disorders of the thyroid gland, and weight loss or obesity diet, were excluded(23). After obtaining written informed consent, the researcher collected demographic and nutritional information of the samples via interview and completing food frequency questionnaire. Those who did not respond to more than 50% of the food frequency questionnaire were excluded (24-26). After excluding those who did not answer more than 50% of the Food Frequency Questionnaire (FFQ), so 250 remained for the final analysis.

Dietary information was collected by the food frequency questionnaire containing 168 types of nutrients along with a standard amount of each nutrient for individuals. The participants were asked to report their consumption frequency of each food item in the past year by the type of food on a daily (e.g., bread), weekly (e.g., rice), or monthly (e.g., fish) basis. The values listed for each meal were calculated using the home-scale guide to grams, then the gram intake of each food per day was calculated for each individual(27). Food items are grouped into one factor based on their degree of correlation. Each score for a particular dietary pattern was calculated by multiplying the amount of each food consumed in that pattern. Then, the participants were classified according to the quota of dietary habits (27-31).In order to identify the dietary patterns and perform principal component analysis, due to the large number of items on the FFQ, the food items were first categorized to 24 food groups, based on the similarity of their nutrients and researchers' opinions, as well as on previous studies(32)

The weight was measured using the Seca 881 digital weighing scale to the nearest 0.1 kg without shoes while wearing minimal clothes. Height was measured to the nearest 1 mm without shoes with shoulders in a normal position. BMI (Body Mass Index) was calculated as weight in kilograms divided by height in meters squared. General obesity was defined as BMI $\geq$ 30 kg/m2. Waist Circumference(WC) and hip Circumference(HC) were measured with an inelastic plastic tape measure according to WHO guidelines(33). Central obesity was defined as WC $\geq$ 88 cm(34-38).

Table 1. Food groups used in the analysis of adult food patterns in Gonabad

	Food Groups	Food Items
1	Refined cereals	Lavash Bread, Baguette Bread, Starch, Wheat Flour, Rice, Macaroni, String, Vermicelli
2	Whole grains	Sangak bread, Taftoon bread, Barberry bread, barley bread, wheat
3	Potato	Potatoes (all preparation methods)
4	Tomato	Tomato, tomato juice, tomato paste, ketchup
5	Egg	Egg whites, egg yolks
6	Processed meats	Hot dogs, sausages, hamburger
7	Legumes	Lentils, cowpeas, beans, peas, cotyledons, soybeans
8	Nuts and seeds	Chickpea, Walnut, Hazelnut, Almond, Pistachio, Peanut, Indian Almond, Sesame, Seeds
9	Solid fats	Butter, Creamy, Creamy cheese, Skim, Chocolate Cheese, Pizza Cheese
10	Salt	Salt
11	Salty snacks	Salted crackers, pretzels, chips, snack, pickles
12	Jam and compote	All kinds of jams and compotes
13	Vegetables	Spinach, lettuce, Carrot, Yellow (winter) squash, cucumber, pepper, mushroom, onion, garlic, green beans, sweet corn, eggplant, mushrooms, celery, cabbage, Brussels sprouts, cauliflower, broccoli
14	Organ meats	Liver, heart, kidney, Chicken liver, gizzard, tripe, head, tongue, brain
15	Red meat	Beef, mutton, camel meat, hamburger
16	Mayonnaise	A variety of mayonnaise and salad dressings
17	Soft drinks	Industrial juices with added sugar, beverages, syrups, non-alcoholic beer
18	Coffee and tea	Tea and coffee
19	chicken and fish	Fish, Tuna, Chicken (all methods of preparation)
20	Fruits	Pears, apricots, cherries, apples, raisins or grapes, bananas, cantaloupe, watermelon, oranges, grapefruit, kiwi, strawberries, peaches, nectarine, tangerine, mulberry, plums, persimmons, pomegranates, lemons, pineapples, fresh figs, dates, dried figs, dried dates, other dried fruit and natural juices.
21	Dairy	Milk, Powdered Milk, Cocoa Milk, Yogurt, Cheese, Pasteurized Curd, Dough, Ice Creams
22	Vegetable oils	Sunflower oil, corn oil, olive oil and olive
23	Cookies	Cakes, muffins, Gaz, roulette, Danish cake
24	Sweet snacks	Sugar, Chocolate, Toffee, Sohan, Pastel, Jelly, Caramel Cream, Chocolate Biscuit, Creamy Biscuit, Wafer, Chewing gum

Demographic characteristics were age, sex, occupation, education marital status the and number of family members. The relationship between, major dietary patterns and demographic factors was assessed.

For statistical analysis, the obtained data were fed in SPSS v.14. The dominant dietary patterns (factors) were identified utilizing factor analysis. The participants were scored for each identified food pattern [25]. Factor scores were categorized as tertiles. Dietary pattern naming was conducted based on the interpretation of the food items per factor and according to previous studies [26]

Continuous and categorical variables were compared across groups using analysis of variance One-way analysis of variance (ANOVA) and Chi-square tests, respectively. The significance level of less than 0.05 was considered for statistical analysis.

Results

The mean age of the participants in this study, was 36.4±13.16 y (range 18-70 y), 112(44.8%) and 138(55.2%) were male and female respectively. 82.4% were married and 17.6% were single.

The mean BMI of the participants was 25.39±3.33 kg/m2 and the mean waist circumference of these individuals was 83.22 ± 12.92 cm, of which 42.8% were overweight, 8.4% were obese and 23.6% had abdominal obesity.

Factor analysis revealed two factors that explained 32.71% of the variance in dietary patterns. The healthy nutritional pattern consisted of poultry, fish, vegetables, organ meat, potatoes, fruits, natural juices, jams and compotes, tomatoes, and dairy, which accounts for 14.74% of the variance in dietary patterns. The unhealthy dietary habit that included sweet snacks, salty snacks, beverages, coffee and tea, mayonnaise, salt, processed meats, refined cereals, red meats, sweets and solid fats accounts for 17.97% of the variance in dietary patterns [Table 2]. Besides, factor loadings of corn, egg, nuts, seeds and pips, liquid fat, and whole grains were less than 0.2 and did not fit into any of the dominant patterns.

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Table 2. Dietary patterns and factor load of food patterns derived from principal component analysis

Food groups	dietary patterns	
	Healthy	Unhealthy
Sweet snacks		0.77
Salty snacks		0.75
Soft drinks		0.66
Coffee and tea		0.52
Mayonnaise		0.49
Salt		0.48
Processed meats		0.45
Refined cereals		0.35
Red Meat		0.31
Cookies		0.28
Solid fats		0.21
chicken and fish	0.65	
Vegetables	0.64	
Organ meats	0.63	
Potato	0.49	
Fruits, natural juices	0.46	
Jam and compote	0.39	
Tomato	0.36	
Dairy	0.33	

The KMO index is 0.56; hence, the data are sufficient, and the significance of Bartlett's Spear Test shows there is a significant correlation between food groups [χ^2 = 1670.62 and p <0.001].

As can be seen in the above table, two major dietary patterns were obtained. The most common factor in the unhealthy nutritional pattern is the sweet snack food group [0.77] and in the healthy dietary pattern, it belongs to the chicken and fish diet [0.65]. Further, the minimum load factor in the unhealthy dietary pattern observes in the solid fat group [0.21] and in the healthy dietary pattern notices in the dairy group [0.33]. The relationship between the healthy and unhealthy eating patterns with the Anthropometric factors of the participants is shown in Table 3.

There were no significant differences between unhealthy diet and height (p=0.82) and waist circumference (p=0.32) variables. The unhealthy dietary pattern was correlated with body weight (p=0.003), hip circumference (p< 0.001) and body mass index (p< 0.001). Also, there were significant relationship between healthy dietary pattern and height (p<0.001), weight (p<0.001), waist circumference (p<0.001), hip circumference (p<0.001) and body mass index (p=0.001).

The unhealthy diet was significantly associated with general obesity (p <0.001) and abdominal obesity (p=0.01). Both general and abdominal obesity measures were significantly associated with Healthy diet pattern (p = 0.003 and p <0.001 respectively).

Table 3. Anthropometric measures across tertiles of major dietary patterns among Gonabad adults.

Variable	Tertiles of Unhealthy pattern			Tertiles of Healthy pattern		
	Tertile1 (n=83)	Tertile2 (n=83)	Tertile3 (n=84)	Tertile1 (n=83)	Tertile2 (n=84)	Tertile3 (n=83)
Height (cm)	166.60±12.50	167.60±10.51	166.78±9.66	166.69±12.31	171.73±8.65	162.49±9.52
		F=0.20, P=0.82			F=16.93, P<0.001	
Weight (kg)	70.27±14.41	67.51±9.13	73.80±10.96	73.57±14.29	71.46±9.76	66.59±1030
		F=6.06, P=0.003			*F=7.88, P<0.001*	
Waist (cm)	84.69±13.32	81.97±13.63	84.50±11.71	88.55±13.01	84.66±9.85	77.95±13.46
		F=1.15, P=0.32			F16.03, P<0.001	
Hip (cm)	101.75±10.26	92.20±15.63	97.20±10.01	103.69±9.57	94.79±12.80	92.69±13.06
		F=12.65, P<0.001			F19.92, P<0.001	
BMI (kg/m^2)	25.15±3.10	24.12±3.46	26.85±3.60	26.36±3.44	24.26±3.14	25.66±3.71
		F=11.03, P<0.001			F=7.77, P=0.001	

P-values reported based on ANOVA test. Data described as mean ±SD

Table 4. General and abdominal obesity across tertiles of major dietary patterns among Gonabad adults.

Variable	Groups	N	Tertiles of Unhealthy pattern			Tertiles of Healthy pattern		
			Tertile1 % (n=83)	Tertile2% (n=83)	Tertile3 % (n=84)	Tertile1 % (n=83)	Tertile2% (n=84)	Tertile3% (n=83)
Weight status	Normal	122	23.0	50.8	26.2	22.1	42.7	35.2
	Overweight	107	51.4	15.9	32.7	44.9	26.1	29.0
	Obese	21	0.0	19.0	81.0	38.1	19.0	42.9
	Sig		χ^2 =59.85, P<0.001			χ^2 =16.39, P=0.003		
Abdominal Obesity	Yes	191	28.3	35.6	36.1	20.4	38.7	40.9
	No	59	49.2	25.4	25.4	74.6	16.9	8.5
	Sig		χ^2 =8.86, P=0.01			χ^2 =60.41, P<0.001		

P-values reported based on chi-squared test.

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Discussion

To our knowledge, this study is the first to identify the dietary patterns among Gonabad people.

In the present study, we report analysis of dietary patterns among 250 adult Gonabad people aged 18–70 and the association of dietary patterns with general and abdominal obesity. Two dietary patterns were identified. The first pattern, the Healthy dietary pattern, was characterized mainly by high consumption of poultry and fish, vegetables, organ meat, potatoes, fruits, natural juices, jams and compotes, tomatoes, and dairy. The second pattern, the Unhealthy dietary pattern, consisted of a combination of sweet snacks, salty snacks, beverages, coffee and tea, mayonnaise, salt, processed meats, refined cereals, red meats, sweets, and solid fats. The identified "Healthy" and "Un healthy" dietary patterns are similar to those reported previously conducted among adults(39-41).

As there were no studies to identify dietary patterns in gonabad, it was not possible to compare the results of this study with other studies. However, the dietary patterns detected in this study are comparable with the findings of other studies in Iran.

Rezazadeh et al. identified two dietary patterns (namely Healthy, and unhealthy) among adult women in Tehran(16). Unhealthy dietary pattern in this study was similar to an Unhealthy dietary pattern with a high intake of refined cereals, processed meats, hydrogenated oil, and sweets.

In Esmaeilzadeh et al, study aimed at identifying the major dietary patterns relation with general obesity and central adiposity among Iranian women. The unhealthy dietary pattern was the same as the unhealthy dietary pattern (with a high intake of refined cereals, processed meats, hydrogenated oil, and sweets) in the present study(42) .

The Healthy dietary Pattern in this study is the same as a healthy dietary pattern of Rezazadeh, mirmiran, azadbakht studies, include a variety of fruits, vegetable, and poultry(6, 16, 43).

Despite inconsistencies between the results derived from different studies around the world, there are some similarities regarding dietary patterns identified among the adult people. Sánchez-Villegas A et al. fined two major dietary patterns(44). The Mediterranean diet, with similar components to the present study contained vegetables, fruits, poultry, nuts and potatoes. In Parl mendez et al, study, among American men and women, vegetables, fruits and milk patterns similar to the present study(45).

Also, in McNaughton et al study, dietary patterns of fruits, vegetables and dairy had the same healthy nutritional habits as found in this study(46).

Other studies have indicated dietary patterns can be can varied and depending on the number of the pattern obtained. In Naja et al. study, three dietary patterns were identified in Lebanese adults: Fast Food/Dessert," "Traditional Lebanese," and "High Protein(47).

The patterns obtained in the present study are derived from the data collected in a particular population of Iran, and therefore, they are not expected to be quite truthful in a population with different eating habits. Because of the geographical, cultural, social and economic differences, these differences are not strange and even the dietary pattern of a city cannot be generalized to the other city of the same country.

In this study, unhealthy dietary pattern was correlated with weight, hip circumference, and body mass index(BMI). Also, individuals in high healthy diet score (tertile 3 group), showed significantly decreased in weight, waist and hip circumference. Individuals in the lowest tertile of the unhealthy dietary pattern score, were less likely to be generally obese whereas, those in the upper tertile of healthy dietary pattern were less likely to be generally and centrally obese.

In the mohammadshahi study, a relationship was established between a healthy diet and a lower body mass index (BMI) and waist circumference. Moreover, the Western dietary pattern has shown a positive correlation with BMI, waist circumference, body fat percentage (27). A healthy diet is usually rich in foods containing low calorie content and more nutrients, so it has a positive effect in weight control. According to a study conducted in Tehran, a healthy dietary pattern had an important role in obesity(48). The results of Safarian and, Mirmiran, showed that adherence to the Western dietary pattern was associated with increased weight, BMI, and waist circumference (47,41). In the study of Rezazadeh et al., It was found that a healthy dietary pattern was inversely associated with BMI and waist circumference(16).

In the study on Iranian women dietary patterns were divided into two healthy and unhealthy pattern and showed that people with the highest quartile of unhealthy dietary patterns were more likely to develop general and abdominal obesity. But people who are in the top quartile range of healthy eating patterns have a lower risk for obesity and abdominal obesity (16, 49).

The results of a cross-sectional study in women teachers in Tehran as well as Mirmiran study showed that adherence to the Western dietary pattern was associated with increased BMI and abdominal obesity. Participants in the highest quartile of a healthy pattern had lower risk of general obesity, also, people with the highest quartiles of unhealthy dietary patterns had higher body mass index (BMI) and general obesity compared to those with the lowest quartiles(43, 50).

The result of aghapour et al showed the participants who had higher scores for the unhealthy and the healthy dietary patterns were more and less likely to have overweight or obesity, respectively, compared to participants with lower scores(24).

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There were many similarities between the dietary patterns obtained in our study and other studies regarding the association of dietary patterns with overweight or obesity.

In this study, unhealthy pattern, like the unhealthy pattern of Rezazadeh study(16) and western pattern of study of esmailzadeh (42), was positively associated with obesity risk. However, in the study of Aghapour et al. No association was found between the healthy dietary pattern and weight status in adolescents(24). Dietary patterns, characterized by high fats, sugars and snacks have not been associated with the risk of overweight or obesity in adolescents(51, 52).

Studies in other parts of the world including the United States (53, 54), Europe (45) and Asia (43) also showed an inverse association between healthy dietary pattern and general and abdominal obesity. McNaughton reported, In English women, dietary patterns of fruits, vegetables, and dairy products were inversely correlated with BMI and waist circumference (46). In another study in the United States, Consumption of whole grains has been associated with lower BMI and waist circumference(53).

The inverse association between healthy pattern and risk of general and central obesity was similar to the results reported in the us (55, 56) and European(57) countries. In other studies, the inverse relation between BMI and weight gain and "whole grains, fruits and vegetables" pattern were reported in men(58) and women(59) who participated in the Nurses' Health Study. In addition, a "low-fat dairy products, grains, and fruit" pattern in American women had a reverse association with annual changes in BMI and WC(60, 61). Otherwise, dietary pattern of meat and fat in American men and women(62) and the dietary pattern of meat and pasta in Italian women and men (63) were positively associated with BMI.

The positive relationship between unhealthy dietary pattern and the likelihood of overweight and obesity may be due to the high intake of animal fats and refined cereals in the unhealthy dietary pattern. High fat intake is known as a risk factor for obesity (64) and refined grains with a high glycaemic index can increase hunger and are effective in boosting overeating(65)..

Inverse Relationship between Healthy Pattern Observed in Recent Study with weight, waist circumferences and Abdominal Obesity maybe because of the effect of foods rich in fiber and complex carbohydrates, low glycemic index and low energy density like vegetables, fruits and legumes(66, 67) and low fat consumption on appetite and food intake(68). While, the positive relation between unhealthy pattern weight and general obesity may be due to excessive consumption of higher glycemic index carbohydrates (refined grains, sugars and sweets) which leads to higher glycemic responses and increased fat synthesis and fat accumulation(69). Moreover, these types of carbohydrates increase hunger and stimulate overeating. On the other hand, increased fat intake, which is observed in unhealthy diets, was considered a risk factor for weight gain. (65).

One of the strengths of the present study was to investigate both sexes and control of the effect of many confounding variables, especially specially dieting and history of diabetes, hypertension and hyperlipidemia.

A number of limitations must be taken into account in the interpretation of our findings. Because of the cross-sectional design of this study, causality cannot be inferred; therefore, our findings need to be confirmed in prospective studies.

Second, the FFQ limits for the assessment of dietary intakes, including the use of memory and the potential for under-reporting and over-reporting, should also be taken into consideration (67).

Conclusion

Two Major dietary Healthy and Unhealthy Dietary patterns were significantly associated with general and abdominal obesity among adults in Gonabad. It is suggested to consider anthropometric measures in determining the relationship between dietary patterns and disease. Further studies with future prospective studies, are required to confirm these findings.

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