ORIGINAL ARTICLE

Dietary Patterns and Metabolic Syndrome among Type 2 Diabetes Patients in Gaza Strip, Palestine

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ABSTRACT

BACKGROUND: The prevalence of metabolic syndrome is raising worldwide; however, the role of diet in the origin of metabolic syndrome is not understood well. This study identifies major dietary patterns among type 2 diabetes mellitus patients with and without metabolic syndrome; and its association with metabolic syndrome components in Gaza Strip, Palestine.
METHODS: This cross sectional study was conducted among 1200 previously diagnosed type 2 diabetes mellitus (both genders, aged 20 - 64 years) patients receiving care in primary healthcare centers in Gaza Strip, Palestine. Metabolic syndrome was defined based on the International Diabetes Federation criteria; dietary patterns were evaluated using a validated semi-quantitative food frequency questionnaire. Statistical analysis was performed using SPSS version 20.
RESULTS: Two major dietary patterns were identified by factor analysis: Asian-like pattern and sweet-soft drinks-snacks pattern. After adjustment for confounding variables, patients in the highest tertile of the Asian-like pattern characterized by a high intake of whole grains, potatoes, beans, legumes, vegetables, tomatoes and fruithad a lower odds for (Metabolic syndrome, central obesity, high triglycerides, low HDL cholesterol and high blood pressure), (OR 0.766 CI 95% (.642-.914)), (OR 0.797 CI 95% (.652-.974)), (OR 0.791 CI 95% (.687-.911)), (OR 0.853 CI 95% (.743-.978)) and (OR 0.815 CI 95% (.682-.973)) respectively, (P value < 0.05 for all). No significant association was found between the sweet-soft drinks-snacks pattern with metabolic syndrome and its components.
CONCLUSION: The Asian-like pattern may be associated with a lower prevalence of metabolic syndrome and its components among type 2 diabetes patients.
KEYWORDS: Dietary patterns, Factor analysis, Metabolic syndrome, Type 2 diabetes mellitus, Palestine

INTRODUCTION

Metabolic syndrome (MetS) is a constellation of abnormal cardio metabolic factors that increase risk of cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM)(1). MetS is a major health problem worldwide; based on the International Diabetes Federation (IDF) appreciation about one quarter of the world's adult population have MetS (2). Several studies show that the prevalence of MetS among T2DM patients is more than double of the prevalence in the general populations (3,4). In fact, insulin resistance and central obesity are considered the main causes of MetS (5,6). Genetic and environmental factors especially unhealthy dietary habits and physical inactivity contribute to MetS development (7,8,9). Dietary patterns is an approach that has been used to investigate diet-disease relations (10,11,12). Dietary pattern is potentially useful in making dietary recommendations because overall dietary patterns might be easy for the public to interpret or translate into diets (13). Some previous studies show that unhealthy dietary pattern is an important factor associated with MetS components such as obesity, diabetes, dyslipidemia, hypertension (HTN) and CVD (14,15,16). In conclusion, the prevalence of MetS is raising worldwide. In addition, people with T2DM who also present the MetS carry a much higher risk of CVD than those who have T2DM alone. Furthermore, the role of diet in the origin of MetS is not understood well (17,18). Therefore, understanding the association between dietary patterns with the MetS and its components may be helpful in reducing the risk of CVD among T2DM patients. To the best of ourknowledge, this is the first study, which examined this association among T2DM patients in Gaza Strip, Palestine. Our study was conducted to compare the dietary patterns between T2DM patients with and without MetS and its association with the MetS components.

MATERIALS AND METHODS

Participants: This cross sectional study was conducted in the years 2015 and 2016 among a representative sample of Palestinian T2DM patients, selected by a cluster random sampling method. A total of 1200 patients, aged 20 - 64 years receiving care in the primary healthcare centers (PHCs) in Gaza Strip, Palestine, were included in the study. Gaza Strip is divided into five smaller governorates, which include North Gaza, Gaza City, Mid Zone, Khan Younis and Rafah.The total number of PHCs in Gaza Strip is fifty-four (19). The PHCs were distributed in each governorate as follows (eight, fourteen, sixteen, eleven and five PHCs respectively). The study sample was distributed according to the number of PHCs in each governorate as follows (178,311, 356, 244 and 111 patients respectively). Pregnant women, lactating women and patients with other types of serious illness such as cancer, acute myocardial infarction or end-stage kidney disease were excluded from the study. The study protocol was approved by the Ethics Committee of Tehran University of Medical Sciences (Code: IR.TUMS.REC.1394.58) and by the Palestinian Health Research Council (Helsinki Ethical Committee of Research PHRC/HC/60/15).Written informed consent was also obtained from each participant.

Assessment of anthropometric measurements: Height was measured in all patients (patients bare footed and head upright) with a measuring rod attached to the balanced beam scale; the height was reported to the nearest 0.5 cm. Weight (kg) was measured using standard scale (Seca); the scale was placed on a hard-floor surface; patients were asked to remove their heavy outer garments and weight was measured and recorded to the nearest 0.1 kg. Furthermore, a stretch-resistant tape was used for measuring waist circumference (WC); WC was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest. The body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters.

Biochemical analyses: After 12 hours' fasting, venous blood samples were collected from all patients in the primary healthcare centers (in the second meeting with the patients) by well trained and experienced nurses. Venous blood (4.0 ml) was drawn into vacationer tubes and was used for blood chemistry analysis. Serum was separated immediately, and the extracted serum was investigated for (Fasting Plasma Glucose (FPG) mg/dl, High-density Lipoprotein Cholesterol (HDL-c) mg/dl and Triglycerides (TGs) mg/dl). Mindray BS-300 chemistry analyzer instrument was used for blood chemistry analysis. The laboratory tests were analyzed in a private licensed laboratory.

Assessment of blood pressure (BP): BP was measured from the left arm (mmHg) by mercury sphygmomanometer. Three readings on different

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days, while the patient was seated after relaxing for at least fifteen minutes in a quiet environment, empty bladder. The average of three measurements was recorded.

Table 1: Food groupings used in the dietary pattern analysis

Food Groups:	Food Items
Refined grains	White breads, toasted bread, cooked white rice, pasta (macaroni, spaghetti and the like)
Whole grains	Wheat bread, corn or canned, cooked cereals (as bulgur and the like)
Potatoes	Boiled potatoes
Beans and legumes	Cooked (lentils, chickpeas, black beans or white)
Red meat	(Beef, lamb), other meat (rabbit, duck), cold meats, hamburger
Organ meat	Beef liver or chicken liver, viscera (tripe, brains and the like)
Poultry	Chicken with skin, skinless chicken
Fish and shellfish products	Mixed fried fish, boiled or grilled fish (sardines, tuna), salted fish, canned water fish, canned fish in oil, (oysters, clams, mussels and the like), shellfish (shrimp and the like)
Fast foods	Meats as mortadella, sausage, pizza, pie
Eggs	Eggs
Low-fat dairy product	Skim milk, skimmed milk powder, yogurt
High-fat dairy products	Whole milk, (condensed milk, milk powder), cottage cheese curd or fresh white cheese, cream cheese or portions, ice cream, chocolate powder and the like, chocolate
Vegetables	Cooked spinach, (cabbage, cauliflower, broccoli), lettuce, onions, (carrots, pumpkin), cooked green beans, (eggplant, zucchini, cucumbers), mushrooms, canned vegetables, cooked green peas, garlic, pepper, (parsley, thyme, bay leaves, oregano, cilantro, mint and the like), avocado
Tomatoes	Tomatoes, tomato sauce (ketchup)
Fruit	Lemons, (oranges, grapefruit and the like), bananas, apple or pear, strawberries, (peach, apricot), fresh figs, (watermelon, cantaloupe, pineapple), papaya, grapes, mango, guava, kiwi, dried fruits (as raisins, prunes), fruits in syrup (juices of fruits, peach, pear, pineapple, fig)
Hydrogenated fats	Margarine, butter, mayonnaise
Vegetable oils	Corn oil, sunflower oil
Olive	Olives, olive oil
Nuts and seed products	Nuts (almonds, peanuts, hazelnuts, walnuts and the like), tahini (sesame seeds)
Sugar, sweets, and desserts	Biscuit, (croissant, pastries), shortbread, brownie, (custard, custard pudding), (jams, honey), sugar, tasty type artificial sweeteners
Snacks	Potato chips, bag of chips
Condiments	Spicy (pepper, chili)
Soft drinks	Soft drinks with sugar (as cola, orange, lemon, fanta and the like), low calorie soft drinks, fruit juice packaging
Beverages	Coffee, decaffeinated coffee, tea
Salt and pickles	Salt, pickles

Assessment of dietary patterns: Data about dietary patterns were collected by an expert nutritionists, using a validated semi-quantitative food frequency questionnaire (FFQ). The FFQ is relatively easy and inexpensive to administer and can be used to measure dietary intake over a

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prolonged time period (20,21). The FFQ in our study contains a list of 98 food items; it was developed, and validated among Palestinian population in 2014 (22). All participants were asked to estimate the number of times per day, week or month he/she consumed these particular food products and the amount usually eaten per food item by making comparisons with the specified reference portion. Common household measures including measuring cups, spoons and a ruler were shown to assist the participants in the estimation process. The answer categories ranged from 1 to 7 times (7 categories) including never, one to three times per month, one to two times per week, three to four times per week, five to six times per week, one time per day or two to three times per day. Dietary patterns were obtained using factor analysis after the classification of food items into 25 groups (Table 1).

Assessment of other variables: Additional information regarding demographic variables was obtained with an interview-based questionnaire. Pilot study was carried out on thirty patients to enable the researcher to examine the tools of the study. The questionnaire and data collection process were modified according to the result of the pilot study. The data was collected by ten qualified data collectors (five nurses and five nutritionists) who were given a full explanation and training by the researcher about the study.

Definition of MetS: MetS was defined according to the IDF definition(23).

Statistical analysis: Dietary intakes were converted into grams per day. Statistical analysis was performed using SPSS version 20. A major difficulty in studying the relation between dietary patterns and disease outcomes is that dietary patterns cannot be measured directly (24). One commonly used statistical method for quantifying dietary patterns is factor analysis (25). Factor analysis was performed to determine the major dietary patterns among T2DM patients. Factor analysis is a useful multivariable statistical tool for investigating dietary patterns (24,25,26). It allows researchers to investigate concepts that are not easily measured directly by collapsing a large number of variables into a few interpretable underlying factors (27,28). This data reduction method identifies independent vectors of variables in a correlation matrix and provides scores that allow individuals to be ranked in terms of how closely they conform to the total pattern (29). In our study, we classified the 98 food items in the FFQ into 25 food groups (Table 1). The food grouping was based on the similarity of nutrient profiles and was somewhat similar to that used in previous studies (30,31). A varimax rotation was used to determine the dietary patterns. For defining food groups in each pattern and simplifying dietary pattern tables, factor loads under 0.2 were excluded (32). The factor load shows the association between food groups and dietary patterns. For determining the number of factors, we considered eigen values > 1, the scree plot and the interpretability of the factors. When a food group was loaded in more than one dietary pattern, only the pattern with a higher factor load was considered in the analysis. A factor score for the two major dietary patterns was calculated. This score for each individual shows the extent to which the dietary pattern is consistent with one of the specified patterns. Higher factor scores show greater consumption of food groups in the pattern and vice versa. The adequacy of data was evaluated based on the value of Kaiser-Meyer-Olkin and Bartlett's test. The Kaiser-Mayer-Olkin coefficient, which represents the adequacy of the sample size for factor analysis and should be greater than 0.5, was calculated. The value obtained was 0.753 in our study. The obtained dietary patterns scores are expressed as tertiles. The chi-square test was used to determine the significant differences between different categorical variables. The differences between means were tested by independent samples t-test and one-way ANOVA. Finally, the odds ratio (OR) and confidence interval (CI) for the MetS and its components across tertiles categories of dietary pattern scores were tested by binary logistic regression. P value less than 0.05 was considered as statistically significant.

RESULTS

A total of 1200 patients with T2DM aged 20 to 64 years old (59.8% females, 40.2% males) were included in this study. All patients were from Gaza Strip. The characteristics of the study population in relation to the presence of MetS or

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its absence is shown in Table 2. The results revealed that the mean age (yrs) for patients with MetS is 55.4±6.9 vs. 40.3±10.1 for patients without MetS. For the following factors (age, gender, marital status, educational level, family number, monthly income and BMI), the difference was statistically significant among T2DM patients with and without MetS (P value < 0.001). In addition, according to the IDF definition, our findings demonstrate that 75.9% of the patients had undesirable WC had MetS. Furthermore, 98.2% of the patients were with high TGs had MeS. With respect to HDL-c, 98.2% of patients who had abnormal HDL-c had MetS. Finally, 94.8% of the patients who had higher BP had MetS. For these risk factors (high WC, high TGs, low HDL-c and high BP), the difference was statistically significant (P value < 0.001).Then, we entered food consumption data for the 25 food groups (Table 1) into the SPSS for factor analysis. The scree plot of eigenvalues indicated two major patterns: 1) Asian-like pattern characterized by a high intake of whole grains, potatoes, beans, legumes, vegetables, tomatoes and fruit as well as a low intake of refined grains, sugar, sweets and desserts; 2) Sweet-soft drinks-snacks pattern, characterized by a high intake of refined grains, sugar, sweets, desserts, snacks and soft drinks.

Table 2: Characteristics of the study populationin relation to the presence of MetS or its absence

Variables		**T2DM (n=1200)**	**MetS (n=748)**	**Non-MetS (n=452)**	**P value**
Age (years)		49.7±11.0	55.4±6.9	40.3±10.1	.001
Gender	Males	482 (40.2)	258 (34.5)	224 (49.5)	
	Females	718 (59.8)	490 (65.5)	228 (50.5)	.001
Marital status	Married	1160 (96.7)	734 (98.1)	426 (94.2)	.001
	Unmarried	40 (3.3)	14 (1.9)	26 (5.8)	
Educational level	Low education	535 (44.6)	451 (60.3)	84 (18.6)	.001
	High education	665 (55.4)	297 (39.7)	368 (81.4)	
Family number	Less than five	429 (35.7)	215 (50.1)	214 (49.9)	
	Five or more	771 (64.25)	533 (69.1)	238 (30.9)	.001
Monthly income (NIS)	≤ 2000 (NIS)	1054 (87.8)	706 (67.0)	348 (33.0)	
	> 2000 (NIS)	146 (12.16)	42 (28.8)	104 (71.2)	.001
BMI (kg/m²)	Mean ± SD	30.2±6.2	33.2±5.6	25.2±3.5	.001
	Yes	985 (82.08)	748 (75.9%)	237 (24.1%)	
Central obesity	No	215 (17.91)	0 (0.0%)	215 (100%)	.001
High triglycerides	Yes	504 (42.0)	495 (98.2%)	9 (1.8%)	
	No	696 (58.0)	253 (36.4%)	443 (63.6%)	.001
Low HDL cholesterol	Yes	487 (40.58)	478 (98.2%)	9 (1.8%)	
	No	713 (59.41)	270 (37.9%)	443 (62.1%)	.001
High blood pressure	≥130/85 mmHg	771 (64.25)	731 (94.8%)	40 (5.2%)	
	<130/85 mmHg	429 (35.75)	17 (4.0%)	412 (96.0%)	.001
In our study, all participants previously diagnosed type 2 diabetes mellitus					

Data are expressed as means ± SD for continuous variables and as percentage for categorical variables. The differences between means were tested by using independent sample t test. The chi-square test was used to examine differences in the prevalence of different categorical variable. P value less than 0.05 was considered as statistically significant.
According to the IDF criteria: Central obesity: Waist circumference (cm): ≥ 94 in men and ≥ 80 in women. High TGs (mg/dl): ≥150 or specific treatment for this lipid abnormality. Low HDL-c (mg/dl):<40 in males and <50 in females or specific treatment for this lipid abnormality. High BP or treatment of previously diagnosed HTN.

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The factor loading matrixes for the two major patterns are shown in Table 3. These two major dietary patterns explained 68.3% and 18.1% of the total variance, respectively. In the present study, the dietary patterns scores were classified as tertiles. Then, the characteristics of the study population were evaluated within the tertiles.

Table 3: Factor loading matrix for major dietary patterns

Food Groups:	Dietary patterns	
	Asian-like pattern	**Sweet-soft drinks-snacks pattern**
Refined grains	0.245	0.271
Whole grains	0.206	-
Potatoes	0.208	-
Beans and legumes	0.223	-
Red meat	-	-
Organ meat	-	-
Poultry	-	-
Fish and shellfish products	-	-
Fast foods	-	-
Eggs	-	-
Low-fat dairy product	-	-
High-fat dairy products	-	-
Vegetables	0.323	-
Tomatoes	0.229	-
Fruit	0.985	-
Hydrogenated fats	-	-
Vegetable oils	-	-
Olive	-	-
Nuts and seed products	-	-
Sugar, sweets, and desserts	0.209	0.249
Snacks	-	0.228
Condiments	-	-
Soft drinks	-	0.998
Beverages	-	-
Salt and pickles	-	-
Percentage of variance explained (%)	68.302	18.183

Values < 0.20 were excluded for simplicity. Total variance explained by two factors: 86.485.

Table 4 shows that patients in the upper tertile of Asian-like pattern were older (53.0±10 vs. 46.1±11 years, P value < 0.001) and had a higher BMI (31.5±6 vs. 28.6±5.6 kg/m², P value < 0.05) compared to those in the lowest tertile. The distribution of patients with regard to marital status, educational level, family size and monthly income was significantly different across the tertiles of the Asian-like pattern (P value < 0.05 for all). On the other hand, only the distribution of patients with regard to educational level and family size as significantly different across the tertiles of the sweet-soft drinks-snacks pattern (P value < 0.05). In addition, we computed the OR and CI for the MetS and its components (according to the IDF definition) across tertiles categories of dietary patterns scores (Table 5). Our findings demonstrate thatafter adjustment for confounding variables, patients in the highest tertile of the Asian-like pattern had a lower odds for the (MetS, central obesity, high TGs, low HDL-c and high BP), (OR 0.766 CI 95% (.642-.914)), (OR 0.797 CI 95% (.652-.974)), (OR 0.791 CI 95% (.687-.911)), (OR 0.853 CI 95% (.743-.978)) and (OR 0.815 CI 95% (.682-.973)) respectively, (P value < 0.05 for all). In addition, no significant association was found between the sweet-soft drinks-snacks pattern with the MetS and its components(P value > 0.05 for all).

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Table 4: Characteristics and dietary intakes of study population by Tertile (T) categories of dietary pattern scores.

Variables	**Asian-like pattern**			**P**	**Sweet-soft drinks-snacks pattern**			**P**
	T1	**T2**	**T3**		**T1**	**T2**	**T3**	
Age (years)								
Mean±SD	46.1±11	50.0±10	53.0±10	.001	49.5±11	48.8±11	50.8±10	.518
Gender %								
Males	34.6	31.1	34.3		30.3	33.6	36.0	
Females	32.5	34.8	32.7	.721	35.3	33.2	31.5	.057
Marital status %								
Married	32.9	33.8	33.3		33.5	33.1	33.4	
Unmarried	45.5	20.0	35.0	.001	27.5	40.0	32.5	.927
Educational level %								
Low education	26.5	32.9	40.6		31.0	31.2	37.8	
High education	38.8	33.7	27.5	.001	35.2	35.0	29.8	.023
Family number %								
Less than five	31.4	30.8	37.8		37.6	33.3	29.1	
Five or more	34.4	34.8	30.8	.004	31.0	33.3	35.7	.001
Monthly income (NIS) %								
≤ 2000 (NIS)	32.5	33.1	34.4		33.0	32.9	34.1	
> 2000 (NIS)	39.1	34.9	26.0	.047	35.6	36.3	28.1	.362
Body Mass Index (kg/m²)								
Mean±SD	28.6±5.6	30.4±5	31.5±6	.005	29.4±6	30.0±6	31.2±6	.347

ANOVA test was used for quantitative variables and chi-square for qualitative variables. P value less than 0.05 was considered as statistically significant.

DISCUSSION

With the use of dietary data from the FFQ, two major dietary patterns were identified in the present study by factor analysis. 1) Asian-like pattern characterized by a high intake of whole grains, potatoes, beans, legumes, vegetables, tomatoes and fruit as well as a low intake of refined grains, sugar, sweets and desserts; 2) Sweet-soft drinks-snacks pattern characterized by a high intake of refined grains, sugar, sweets, desserts, snacks and soft drinks.

To the best of our knowledge, this is the first study which describes the dietary patterns among T2DM patients with and without MetS and its association with the MetS components in Gaza Strip, Palestine. In addition, few studies are available about dietary patterns and the MetS which made the comparison of our results with previous studies difficult. Naja et al. (33) reported three dietary patterns: Fast food/dessert pattern, traditional Lebanese pattern and high protein. The findings of this study demonstrate a positive association of the fast food/dessert pattern with MetS and hyperglycemia among Lebanese adults. The fast food/dessert pattern was characterized by high intake of fast foods sandwiches, pizzas, pies, desserts, carbonated beverages and juices. Choi et al. (34) identified three dietary patterns labeled: Traditional pattern, western pattern and prudent pattern. The prudent pattern characterized by high intake of fruits, fruit products, nuts, dairy and a low intake of grains. The findings of this study

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Table 5: Odd ratio and confidence interval for the MetS and its components across tertiles categories of dietary pattern scores.

Asian-like pattern					Sweet-soft drinks-snacks pattern				
T1	**T2**	**T3**	**P value**	**OR (95%CI)**	**T1**	**T2**	**T3**	**P value**	**OR (95%CI)**
Metabolic syndrome:									
30.5	31.4	38.1	0.001	0.751(.660-.853)	25.9	35.3	38.8	0.001	0.610(.535-.696)
Adjusted*			0.003	0.766(.642-.914)	Adjusted*			0.317	0.912(.762-1.092)
Central obesity: WC ≥ 94 cm in men and ≥ 80 cm in women									
29.2	34.9	35.9	0.001	0.552(.462-.660)	32.6	33.1	34.3	0.030	0.836(.711-.983)
Adjusted*			0.027	0.797(.652-.974)	Adjusted*			0.345	0.913(.755-1.104)
Triglycerides ≥150 mg/dl or specific treatment for this lipid abnormality									
28.8	30.8	40.4	0.001	0.782(.696-.878)	24.0	33.5	42.5	0.001	0.678(.602-.764)
Adjusted*			0.001	0.791(.687-.911)	Adjusted*			0.213	0.913(.790-1.054)
HDL cholesterol <40 mg/dl in males and <50 mg/dl in females or specific treatment for this lipid abnormality									
29.8	30.2	40.0	0.001	0.822(.732-.922)	24.0	33.0	43.0	0.001	0.693(.616-.781)
Adjusted*			0.023	0.853(.743-.978)	Adjusted*			0.329	0.932(.808-1.074)
High BP or treatment of previously diagnosed HTN									
30.7	31.9	37.4	0.001	0.773(.679-.879)	26.6	35.9	37.5	0.001	0.648(.569-.739)
Adjusted*			0.024	0.815(.682-.973)	Adjusted*			0.793	1.025(.855-1.229)
In our study, all participants previously diagnosed T2DM									

The OR and CI for the MetS and its components across tertiles categories of dietary pattern scores were tested by binary logistic regression. * Adjusted for age, marital status, educational level, family number and monthly income. P value less than 0.05 was considered as statistically significant.

demonstrate a negative association of the prudent pattern with MetS among Korean women.

Esmaillzadeh et al. (35) identified three dietary patterns: Healthy pattern, Western pattern, and traditional pattern. The author concluded that healthy pattern (high in fruits, tomatoes, poultry, legumes, cruciferous, green leafy vegetables, other vegetables, tea, fruit juices and whole grains) was associated with lower risks of MetS, whereas the Western pattern (high in refined grains, red meat, butter, processed meat, high-fat dairy products, sweets and desserts, pizza, potatoes, eggs, hydrogenated fats, and soft drinks and low in other vegetables and low-fat dairy products) was associated with higher risks of MetS. No significant association was found between traditional pattern and MetS among women in Iran. Williams et al. (36) showed that a dietary pattern characterized by high consumption of fruit and vegetables and low consumption of processed meat and fried foods was inversely associated with MetS and its components among British the population. The results of our study support these findings. The previous dietary patterns are different from those obtained in our study. This can be explained by demographic, cultural and ethnic differences.

Our findings demonstrate that after adjustment for confounding variables, the Asian-like pattern may be associated with a lower prevalence of (MetS, central obesity, high TGs, low HDL-c and high BP). The inverse association between Asian-like pattern with the MetS and its components could be attributed to pattern's

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healthy ingredients including vitamins, dietary fibers, potassium, magnesium and antioxidants. These nutrients have been independently associated with reduced metabolic risks related to MetS. Soluble dietary fibers in these foods may decrease the intestinal absorption of cholesterol and bile salts, which may improve serum lipid profile (37). Magnesium and potassium in many fruits and vegetables could contribute to lower BP (38). Furthermore, antioxidants in these foods may have beneficial effects on the risk of MetS (39). Moreover, vegetables and fruits increase satiety and may be associated with a lower risk of obesity (40). In our study the Asian-like pattern has been shown to be the healthiest dietary pattern. Which also, low in animal foods, saturated fat, trans fat, cholesterol and simple sugar, which may be associated with a higher risks of MetS and its components (36). ccording to the Dietary Approaches to Stop Hypertension, diets high in fruits, vegetables and low in fat may be associated with a lower risk of HTN, decreased (Weight, BMI, serum TGs, very low density lipoprotein cholesterol levels) and increased concentrations of plasma total antioxidant capacity (41,42). In the present study, no significant associations were found between the sweet-soft drinks-snacks pattern with the MetS and its components. Many previous studies show that the dietary patterns characterized by a high intake of refined grains, sugar, sweets, desserts, snacks and soft drinks were positively associated with the risk of MetS and its components (43,44,45). Our study not adjusted for other confounding variables such as physical activity, types of diabetes drugs, genetics and psychological factors, which could contribute to these results. Actually, the relationship between dietary patterns with the MetS and its components need more studies in the future. In this study, the mean age of the patients in the upper tertile of Asian-like pattern was significantly higher than that of the lower tertile, and those in the lower tertile of sweet-soft drinks-snacks pattern were younger than those in the upper tertile. Furthermore, we found a significant relationship between Asian-like dietary pattern and age, marital status, educational level, family size and monthly income (P value < 0.05 for all). Rashidkhani et al. (46) found a significant correlation between age, educational level and total monthly income with a healthy dietary pattern. The results of our study support this finding. Finally, the variance explained by the Asian-like pattern (68.3%) was higher than that explained by the sweet-soft drinks-junk foods pattern (18.1%). It seems that T2DM patients trying to change their dietary behaviors toward the Asian-like pattern. The main limitation of this study is its cross sectional design; the causal relationship could not be determined, and it limits the generalizability of our results. In addition, the possibility of recall bias and misreporting by using FFQ assessment of dietary patterns. Moreover, it is possible that the presence of chronic diseases can lead to changes in dietary patterns. The main strength of this study was its being the first study which shows the dietary patterns among T2DM patients with and without MetS and its association with the MetS components in Gaza Strip, Palestine.

In conclusion, the Asian-like pattern may be associated with a lower prevalence of MetS and its components among T2DM patients in Gaza Strip, Palestine. Further future studies are required to confirm these findings.

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