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Mediterranean diet and metabolic syndrome prevalence in type 2 diabetes patients in Ahvaz, southwest of Iran

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ABSTRACT

Aims: Metabolic syndrome as a cardiovascular disease predictor, is proposed to be reduced by following a Mediterranean diet. This study was aimed to explore the relationships between metabolic syndrome and Mediterranean diet in type 2 diabetes mellitus patients.
Materials: A cross-sectional study was performed on 158 type 2 diabetes mellitus patients 28–75 years old (mean age: 54.3 ± 9.6 yrs). Fasting glucose and lipid profile were measured. Blood pressure and anthropometric characteristics of each participant were recorded. Food frequency questionnaires were evaluated using an 11-item score to determine the adherence to Mediterranean diet.
Results: Totally, 55.4% of participants had a good adherence to Mediterranean diet. The risk of metabolic syndrome in women was significantly higher than in men (OR = 8.65, CI 95% = 2.88–25.99; $p < 0.001$). Nuts, legumes and seeds consumption were associated with a significant lower risk of metabolic syndrome (OR = 0.42, CI 95% = 0.188–0.917; $p < 0.05$). No considerable association was observed between metabolic syndrome and adherence to Mediterranean diet ($p = 0.167$).
Conclusions: Results demonstrated no association between Mediterranean diet adherence and metabolic syndrome in type 2 diabetes mellitus patients. However, nuts, legumes and seeds might have greater benefits for diabetics.

1. Introduction

Type 2 diabetes mellitus (T2DM) is one of the main causes of cardiovascular disease (CVD) [1] and one of the key components of metabolic syndrome (Met S), a collection of cardiovascular disease risk factors, including low High density lipoprotein cholesterol (HDL-C), elevated triglycerides, elevated blood pressure, central adiposity, and elevated fasting blood glucose [2].

CVD is responsible for about one third of all deaths among diabetics [3]. In 2010, the prevalence of Met S amongst T2DM patients in Ahvaz was estimated 73.1% and 64.9% according to National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP-III) and International Diabetes Federation (IDF) criteria, respectively [4]. This indicates an alarming situation of CVD outcomes in the near future that requires immediate preventive strategies.

According to a systematic review, the Mediterranean diet (MD) was the most likely dietary model protecting against coronary heart disease [5]. An inverse association between MD scores and cardiovascular and neurodegenerative diseases and some types of cancer has been suggested [6,7]. Moreover, it seems that MD has a favorable effect on development of the Met S [8].

MD is originated from the traditional diet of olive growing Mediterranean region, where was historically among the lowest chronic disease incidences and the highest life expectancies in the world [9]. This diet consists of high consumption of whole grains, legumes, vegetables, fruits and cereals, nuts, seeds and olive oil as the main dietary fat, moderate intake of fish and poultry, up to four eggs in a week, moderate to low consumption of meat and dairy products, and rarely sweet or honey consumption [10].

Up to now, few studies have explored the benefits of following a Mediterranean-type diet on cardiovascular health of T2DM

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patients. A recent clinical trial in Italy demonstrated more controlled coronary risk factors in T2DM patients adhered to MD in comparison to a low-fat diet [11]. MD association with Met S has been frequently evaluated in Mediterranean population. Although, only few studies have assessed this relationship in non-Mediterranean populations [12–14], especially in diabetics [15–17]. This was the first study examined the association between metabolic syndrome prevalence in relation to following the Mediterranean diet in a group of Iranian T2DM patients. It would expand the knowledge on applicability of this dietary pattern to control CVD risk factors in this population.

1.1. Subjects

Participants were 158 T2DM outpatients attending to Diabetes Clinic of Golestan Hospital, Ahvaz, Khuzestan province, Iran. All participants provided a written consent form before participation. The study was approved by Ahvaz Jundishapur University Research Ethics Committee (Ethic code: IR.ajums.rec.1394.55).

2. Materials and methods

Inclusion criteria were included previously diagnosed diabetes by a general practitioner on the basis of the ADA (American Diabetes Association) criteria [18], age between 20 and 75 years, and being treated with diet or oral hypoglycemic agents. Insulin therapy; dietary changes within the last three months; cardiovascular events in the last year; having cancer or any serious disease were considered as exclusion criteria.

After 12 h fasting, 5 mL venous blood samples were collected from all participants. Samples were analyzed for fasting blood sugar (FBS), total cholesterol, HDL-C, low density lipoprotein cholesterol (LDL-C) and triglycerides (TG) levels using standardized enzymatic colorimetric and photometric methods. All biochemical analyses were performed at the Central Laboratory of Health Research Institute, University Diabetes Research Center.

Serum Cholesterol, TG, FBS, and HDL-C was measured by enzymatic methods (Pars Azmun kits, Pars Azmun Co., Karaj, Iran) using auto-analyzer (B.T. 3000, Biotecnica instruments, Italy). Friedewald equation was used to calculate LDL-C levels [19].

Data on age, sex, smoking status, physical activity, and anthropometric measures was recorded for each participant. Physical activity was extracted using the International Physical Activity Questionnaire as MET-min/week [20]. Anthropometric measurements, including weight, height, body fat percentage and waist-circumference (WC) were measured by a trained dietician. Weight and body fat percentage were measured with minimal cloth without shoes, using a digital scale and recorded to the nearest 100 g (Omron 212, Omron Corp., range 0.1–150 kg, Germany). Height was measured using a tape meter without shoes and recorded to the nearest 0.1 cm. Body mass index (BMI) was calculated as weight in kg divided by squared height in meter (kg/m^2). WC was measured at the narrow middle part between the lowest rib and the iliac crest over light clothing, using a flexible tape measure, without any pressure to body surface and was recorded to the nearest 0.1 cm. Waist-height ratio (WHtR) was calculated by dividing waist in meter by height in meter.

A validated 86-item food frequency questionnaire (FFQ) was used to assess usual dietary intake of the participants over the past year. USDA (US Department of Agriculture) serving-sizes or household measures were used to record each food item. The FFQ was filled by a trained nutritionist. Then the reported portion-size was converted to grams, and the nutrients and energy content were then calculated by Nutritionist IV (N4) software (version 4.0; N-squared Computing, Salem, OR, USA) modified according to the Iranian Food Composition Table [21]. FFQs were scored according to an 11-item validated Mediterranean diet scoring system [22]. Each item was scored from 0 to 4, according to the protocol. Over- or under-reporters were determined as having ±3 standard deviation (SD) of the mean energy intake.

Results of the quantitative variables were reported as mean ± SD, and categorical variables were presented as percentage. Categorical

Table 1
Basic characteristics of the participants.

Variables	Low adherence to MD ($n=70$)	High adherence to MD ($n=87$)	p value
Mediterranean score	18.19 (2.56)	26.43 (3.14)	<0.001**
Female/male	51/19	53/34	0.116
Age (yrs)	54.31 (9.96)	54.59 (8.97)	0.858
Diabetes duration (yrs)	6.44 (6.40)	6.29 (6.68)	0.887
Age at diagnosis (yrs)	47.779 (10.78)	48.19 (9.58)	0.800
BMI (kg/m^2)	29.06 (4.64)	29.42 (5.36)	0.656
WC (cm)	98.01 (10.03)	98.87 (10.38)	0.601
WHtR	0.62 (0.07)	0.61 (0.08)	0.565
Body fat%	37.38 (9.47)	35.54 (10.73)	0.258
Metabolic syndrome (%)[a]	88.6%	80.5%	0.167
Laboratory data			
FBS (mg/dL)	151.50 (55.91)	162.39 (82.74)	0.348
Total chol (mg/dL)	168.94 (36.25)	175.03 (40.78)	0.515
TG (mg/dL)	150.94 (68.66)	160.06 (99.28)	0.330
HDL-C (mg/dL)	43.23 (9.42)	44.82 (10.03)	0.313
LDL-C (mg/dL)	95.71 (29.91)	99.87 (31.56)	0.403
SBP (mmHg)	131.67 (19.75)	129.21 (18.31)	0.420
DBP (mmHg)	84.36 (11.27)	82.60 (10.06)	0.304
PAL(MET-min/week)	1249.516 (2021.52)	1221.87 (2196.22)	0.935
Dietary intake			
Energy	2422.51 (812.0)	2726.46 (910.58)	0.031*
CHO (%)	59.09 (8.23)	57.14 (9.34)	0.173
Protein (%)	12.54 (2.00)	13.97 (2.16)	<0.001**
Fat (%)	28.29 (8.50)	28.68 (9.25)	0.785
SFA (%)	5.79 (2.13)	6.17 (2.29)	0.280
MUFA (%)	8.21 (3.79)	8.90 (3.81)	0.265
PUFA (%)	9.94 (4.82)	9.18 (4.64)	0.318
Fiber (g)	17.15 (7.32)	24.61 (8.72)	<0.001**
Soluble fiber (g)	0.45 (0.38)	0.67 (0.48)	0.002*
Insoluble fiber (g)	2.58 (2.02)	4.12 (2.65)	<0.001**
MUFA:SFA	1.42 (0.44)	1.44 (0.45)	0.869

Values are mean (SD) unless specified.
BMI, body mass index; CHO, carbohydrate; Chol, cholesterol; cm, centimeter; DBP, diastolic blood pressure; FBS, fasting blood sugar; g, gram; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; yrs, years; MUFA, mono unsaturated fatty acid; PUFA, poly unsaturated fatty acid; SBP, systolic blood pressure; SFA, saturated fatty acid; TG, triglyceride; WC, waist circumference; WHtR, waist-height ratio.
[a] Diagnosed based on IDF (2006)[2].
* $p<0.05$.
** $p<0.001$.

Table 2
Difference in Mediterranean diet components between two adherence groups.

Mediterranean diet components	High adherence to MD	Low adherence to MD	p value
Whole grain (ex/d)	0.34 (0.64)	0.96 (2.54)	0.031*
Vegetables (ex/d)	2.15 (1.50)	3.82 (1.68)	0.000**
Fruits (ex/d)	2.87 (2.21)	4.01 (2.23)	0.002*
Nuts, legumes, seeds (ex/d)	0.52 (0.44)	0.95 (0.67)	0.000**
Olive (time/d)	0.16 (0.30)	0.68 (0.86)	0.000**
Dairy(ex/d)	1.45 (1.14)	2.22 (1.06)	0.000**
Meat (ex/wk)	2.39 (2.48)	2.27 (2.68)	0.773
Poultry (ex/wk)	1.93 (1.63)	2.79 (2.23)	0.007*
Egg (no./ wk)	1.79 (2.05)	1.65 (1.42)	0.626
Fish (ex/wk)	1.63 (1.78)	3.09 (2.98)	0.000**
Sweets (Time/wk(	12.23 (8.27)	7.61 (9.64)	0.002*

Values are Mean (SD) unless specified. D, day; ex, exchange; MD, Mediterranean diet; No., number; Wk, week.
* $P<0.05$
** $P<0.001$