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Major dietary patterns in in obese/overweight patient with/without metabolic syndrome compared to normal weight subjects

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ABSTRACT

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Background: The term metabolic syndrome (MetS) refers to one of the most challenging public health issue in worldwide; however diet modification is considered as the first step in management and treatment of MetS and its components. In the present study we investigated major dietary patterns in patients with MetS compared to weight matched and normal weight control subjects.
Methods: In a case-control study 147 Iranian adults from the Endocrinology Center of Tehran University of Medical Sciences were recruited. Subjects were divided in to 3 groups, according to MetS definition and BMI cutoffs. NCEP ATP III criteria were used for identifying subjects with MetS. FFQ was used for assessment of dietary intake.
Results: Two dietary patterns were identified; Western dietary pattern and traditional dietary pattern. Compared with participants in lowest quartile, subjects with highest quartile of traditional dietary pattern and lowest quartile of western dietary pattern had significantly lower BMI, WC, weight, fat mass, abdominal fat, SBP, DBP, FBS and TG and higher HDL cholesterol and fat free mass ($p<0.05$).
Conclusion: Our findings indicated that western dietary pattern can be considered as a risk factor for metabolic syndrome and its components.

Introduction

The term MetS refers to a cluster of risk factors for CVD, including central obesity, reduced HDL (high-density lipoprotein), hypertriglyceridemia, high blood pressure (BP), and hyperglycemia [1,2]. This syndrome is associated with a 2-fold increase in the risk of developing CVD and a 6- fold increase in the risk of developing type 2 diabetes mellitus (T2DM) [3].

MetS has recently become a challenging public health issue in worldwide [4]. The prevalence of this syndrome is increasing rapidly in worldwide according to the National Health and Nutritional Examination Survey (NHANES)

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[5]. Based on available evidence, 20-30% of the adult population in most countries is affected by the MetS [6]. Based on ATPIII definition, the prevalence of this syndrome among Iranian adults is 33.2% [7]. These prevalence rates are among the highest in the world [8].

In spite of various pathogenic mechanisms proposed, the etiology of the MetS still remains controversial. Although MetS is considered as a consequence of obesity, a proportion of obese patient do not affected by MetS (healthy obese) [9,10].

MetS is considered as a multifactorial disorder [11], however emphasis of the available guidelines are on healthy lifestyle such as diet modification, as the first step in management and treatment of MetS and its components [12]. Since each individual's food consumption is in terms of a pattern-like manner, it appears that studying dietary patterns and effect of the diet as a whole rather than single nutrients or foods may be more informative [13-15].

Despite the known effects of dietary factors on the development of MetS, to the best of our knowledge, no previous studies have examined dietary pattern in obese/overweight patient with MetS compared to obese/overweight patient without MetS as well as normal subjects [16, 17]. The aim of current study was to test the hypothesis that dietary pattern differ between patients with MetS and comparable age and sex matched control groups.

Methods

In this case-control study we compared 147 Iranian men and women adults aging in the range of 20-55 years old. The subjects were recruited from the Endocrinology Center of Tehran University of Medical Sciences. Forty nine overweight/obese patients with MetS and never receiving medications were considered as case group. Age and gender matched to the patient with MetS made up of 49 weights matched overweight/obese subjects (without MetS) and 49 normal weight subjects without MetS were recruited as control groups. Subjects were selected with a sequential sampling method. An informed consent was obtained from all the subjects participating in the study.

NCEP ATP III criteria were used for identifying subjects with MetS. The ATPIII definition requires the presence of three or more of the following: (a) waist circumference greater than or equal to 102 cm for men and greater than or equal to 88 cm for women, (b) triglyceride level greater than or equal to 150mg/dL, (c) high-density lipoprotein (HDL) cholesterol less than 40 mg/dL for men and less than 50 mg/dL for women, (d) systolic blood pressure greater than or equal to 130 and/or diastolic blood pressure 85 mmHg and (e) fasting glucose greater than or equal to 100 mg/dL.

Having a history of coronary artery disease, acute or chronic renal failure, acute infection within the previous seven days, acute or chronic hepatic failure, hematological disorder, presence of any chronic inflammatory or autoimmune disease and any known malignancy, pregnancy, breast feeding, post-menopause, smoking, being a professional athlete, uncontrolled thyroid disorder, use of medications for dyslipidemia or hypertension, use of hypnotics, sedatives and immunosuppressive or having a special diet for any reason prescribed by a dietitian were considered as exclusion criteria.

Standing height was measured with a standard stadiometer to the nearest 0.1 cm. Body Weight was measured to the nearest 0.1 kg by a balanced beam scale (Seca Corp. Scale, Germany). Body mass index (BMI) was calculated as body weight divided by height squared (kg/m2). Waist circumference (WC) was measured by a flexible and non-elastic tape measure in the midline between the lower rib margin and the iliac crest. Levels of TG, HDL-c and FBS were evaluated from patient medical chart records.

The semi-quantitative FFQ, consisted of 168 items, was used for assessment of dietary intake. The questionnaire was completed by a trained dietitian.

Statistical analysis

Data analysis was performed using SPSS for Windows (version 16.0; SPSS Inc., Chicago, IL, USA). All values were expressed as mean ± SD. We categorized participants by quartile of dietary pattern scores. One-way ANOVA was used to evaluate significant differences in general characteristics, MetS components and body composition across quartile categories of dietary pattern scores. When the result of the ANOVA test was significant, a LSD test was used to locate which of the means differed. For all analyses, $p<0.05$ was considered statistically significant. Factor analysis was used to identify dietary patterns, 168 items in FFQ questionnaire according to similarity of nutrients and previous studies were classified into 32 food groups.

Table 1. General characteristics of subjects based on study groups

		Obese with MetS (n= 49)	Obese without MetS (n=49)	Normal weight without MetS (n=49)	Total (n=147)	*P-value
		N(%)	N(%)	N(%)	N(%)	
Sex*	male	45(91.8)	46(93.9)	45(91.8)	136(92.5)	0.906
	female	4(8.2)	3(6.1)	4(8.2)	11(7.5)	
Marital status*	single	8(16.3)	13(26.5)	15(30.6)	36(24.5)	0.390
	Married	41(83.7)	36(73.5)	34(69.4)	111(75.5)	
Age**	20-29.9	6(12.2)	10(20.4)	15(30.6)	31(21.1)	0.277
	30-39.9	27(55.1)	23(46.9)	24(49)	74(50.3)	
	40-55	16(32.7)	16(32.7)	10(20.4)	42(28.6)	

*Chi-square, **Fisher

Table 2. Comparison of biochemistry and anthropometric parameters among subjects based on study groups

	Obese with MetS (n= 49)	Obese without MetS (n=49)	Normal weight without MetS (n=49)	Total (n=147)	*P-value
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
FBS(mg/dL)	109±48[a]	93.7±16.9[b]	91.8±6.4[b]	98.2±30.2	0.008
TG (mg/L)	199.8±95.5[a]	119±58.5[b]	109.7±54.4[b]	143±82.2	<0.001
HDL-c (mg/dL)	52.2±7[a]	54.2±7	56.2±8[b]	54.2±7.4	0.029
SBP (mm-Hg)	135.9±12.76[a]	127.6±14.3[b]	118.9±12.2[c]	127.5±14.7	<0.001
Height (cm)	172.± 6.7a	172.8±6.9a	172.3± 7.7a	172.4± 7	0.862
Weight (Kg)	88.7± 11.9a	88/6± 11.4a	68.5± 10.4b	81.7± 14.7	<0.001
Waist circumference (cm)	106.3± 7.47a	102.7± 10.2b	88.3± 6.9c	99± 11.3	<0.001
BMI (kg/m^2)	29.9± 3.27a	29.7± 3.21a	22.9± 2.32b	27.5± 4.4	<0.001

FBS; Fasting blood sugar, TG; Triglyceride. HDL-c: Height density lipoprotein
Values are analyzed by one–way ANOVA, values are mean ± SD. Dissimilar values (a, b, c) of each row are significantly different.

Table 3. Factor-loading Matrix among case and control subjects

	Component	
	Traditional	Western
Processed meat	-.319	.527
Red meats	-.153	-.454
Organ meats	-.252	.575
Fish	.585	-.458
Poultry	.617	-.610
Egg	-.390	.260
Low fat dairy	.665	-.442
High fat dairy	.025	-.437
Tea	-.369	.028
Coffee	.291	-.478
Fruit juices	.698	-.129
Yellow vegetables	.918	-.039
Tomatoes	.882	-.127
Legumes	.659	-.247
Garlic	.833	-.044
Potatoes	-.260	.475
French fries	-.109	.409
Whole grains	-	-
Refined grains	-.357	.444
Snacks	-.297	.380
Nuts	.561	-.232
Sweets and desserts	-.265	.499
Pickle	-.189	.314
Sugars	-.382	.460
Soft drinks	-.369	.521
Yogurt drink	.690	-.317
Butter margarine	-.464	.570
Spice salt	-.073	-.331
Fruit	.604	-.531
Hydrogenate oil	-.367	.705
Vegetables oil	.155	-.786
Other vegetables	.877	-.242

Value <0.2 were excluded for simplicity

Factor analysis of principal components with varimax on food groups classified was used to determine the dominant dietary patterns.

Results

Table 1 describes the general characteristics of subjects based on study groups. Of the 147 participants included in the study, 92.5% were male and 7.5% were female. The mean (±SD) age of the participants was 35.5±7.3 yr. there was no significant difference between study groups in terms of sex, age and marital status (p>0.05 for all). Mean of biochemistry and anthropometric parameters of subjects based on study groups are displayed in Table 2. FBS, TG, BMI, SBP, WC and weight was higher in patients with MetS, while mean of HDL-C was lower in this group of subjects (p<0.05 for all). The factor loading matrixes for dietary patterns are shown in Table 3. We identified 2 dietary patterns by using factor analysis: Western dietary pattern (processed meat, red meat, organ meats, high fat dairy, coffee, potatoes, French fries, refined grains, snacks, sweets and desserts, pickle, sugar, soft drink, butter margarine, spice, salt, hydrogenated oil and vegetable oils) and the traditional dietary pattern which was (fish, poultry, egg, low fat dairy, tea, fruit juices, yellow vegetables, tomatoes, legumes, garlic,

Table 4. Characteristics and body composition of study participants by quartiles (Q) categories of dietary pattern scores

	Q1	Q2	Q3	Q4	p
Healthy dietary pattern					
BMI (kg/m2)	29.762±3.31[a]	28.518±4.04[a]	27.645±4.67	24.225±3.23	<0.001
WC(Cm)	101.722±8.36	101.405±12.31	99.945±11.85	92.828±9.44	0.001
Weight (Kg)	88.603±9.58	84.824±15.22	82.651±15.85	71.222±11.17	<0.001
Fat free mass (%)	76.5804±5.62	78.836±9.25	78.629±8.24	82.090±6.73	0.035
Fat mass (%)	23.093±5.12	22.248±6.43	21.351±8.20	17.911±6.72	0.012
Abdominal fat (%)	25.731±5.45	24.133±7.76	23.134±9.15	18.830±7.56	0.003
SBP (mmHg)	131.666±10.00	124.459±14.51	130.405±17.49	121.285±12.26	0.005
DBP (mmHg)	84.722±8.69	81.805±10.22	84.108±9.73	78.142±10.50	0.023
FBS (mg/dl)	94.416±10.48	101.941±49.79	96.878±12.55	93.441±7.11	0.547
HDL (mg/dl)	53.611±6.67	54.057±7.30	52.911±7.55	56.529±8.19	0.211
TG (mg/dl)	159.333±85.32	144.028±74.34	154.911±96.97	122.323±59.10	0.227
Western dietary pattern					
	Q1	Q2	Q3	Q4	p
BMI (kg/m2)	23.779±3.89	26.809±3.08	28.152±2.90	31.046±4.11	<0.001
WC	91.171±11.35	96.631±8.54	99.666±7.68	108.611±9.24	<0.001
Weight (Kg)	69.455±12.14	78.439±10.45	83.297±9.42	94.909±13.85	<0.001
Fat free mass (%)	83.145±7.16	79.093±9.56	78.758±5.48	75.465±6.82	0.001
Fat mass (%)	16.864±7.14	21.975±6.09	20.961±4.97	24.521±6.77	<0.001
Abdominal fat (%)	17.532±7.88	23.775±7.07	23.094±6.61	27.009±7.73	<0.001
SBP (mmHg)	119.571±14.21	125.657±13.81	127.916±14.16	134.722±11.58	<0.001
DBP (mmHg)	75.714±10.65	80.189±8.09	84.305±9.34	88.611±7.33	<0.001
FBS (mg/dl)	95.193±5.77	93.250±11.01	92.970±9.80	104.722±48.45	0.002
HDL (mg/dl)	56.677±6.31	55.611±7.16	52.500±8.85	52.611±6.63	0.041
TG (mg/dl)	111.161±49.60	127.250±66.96	174.888±107.25	163.333±70.12	0.190

Values are analyzed by one–way ANOVA, values are mean ± SD

Table 5. OR from multinomial logistic regressions for risk factors among cases and Overweight/obese in comparison to normal weight persons

	Obese with MetS (CI 95 %)	Obese without MetS (CI 95 %)
Traditional dietary pattern	0.19(0.09- 0.40)	0.18(0.09- 0.36)
Western dietary pattern	17.67(5.59-5.83)	6.49(2.39- 17.60)

whole grain, nut, yogurt drink, fruit and other vegetables). Obese/overweight patients with and without MetS had the highest score of western dietary pattern and the lowest score of traditional dietary pattern, while normal subjects had the highest score of traditional dietary and the lowest score of western dietary pattern. MetS components and body composition parameters of the study participants across quartile categories of the dietary pattern scores are shown in Table 4. Compared with participants in lowest quartile, subjects with highest quartile of traditional dietary pattern had significantly lower BMI, WC, weight, fat mass, abdominal fat, SBP, DBP, FBS and TG and higher HDL cholesterol and fat free mass. Conversely, in comparison with lowest quartile, subjects with highest quartile of western dietary pattern had significantly higher BMI, WC, weight, fat mass, abdominal fat, SBP, DBP, FBS and TG and lower HDL cholesterol and fat free mass. The outcome Odds Ratio (OR) from multinomial logistic regressions for overweight/obese patient with and without MetS in comparison to normal weight persons is reported in Table 5. With an increase of 1 unit in the score of western dietary pattern, the odds of patient with MetS to normal participants increase by 17.67 times (Table 5).

Discussion

In this comparative study we identified two dietary patterns: Traditional dietary pattern and western dietary pattern. Participants with the highest quartile of traditional dietary pattern were significantly less likely to be obese and have MetS than those with the lowest quartile, furthermore mean of SBP, FBS, TG, BMI and WC were lower in this group whereas mean of HDL was the highest in this group. Patients with MetS had the highest score of western dietary pattern and the mean of SBP, FBS, TG, BMI and WC while the normal subjects had the lowest score of this dietary pattern. Compared to subjects without MetS components, subjects with MetS component were more likely to have a western dietary pattern and had higher means of SBP, FBS, TG, BMI and WC and lower HDL. Overall the traditional dietary pattern was associated with lower risks of MetS, whereas the western dietary pattern was associated with higher risks of this syndrome. According to multinomial logistic regressions, obese/overweight patient with Mets have 17.67 times odds for following western dietary pattern compared normal subjects, this odds for obese/overweight patient without Mets was 6.49. In a cross-sectional study conducted by Williams et al, a dietary pattern with high consumption of fruit and vegetables and low consumption of processed meat and fried foods was inversely associated with metabolic syndrome components [18]. Another study in Iranian women reported that healthy dietary pattern was associated with lower risks of MetS, whereas the western dietary pattern was associated with higher risks of this syndrome [13]. A population-based cohort study in Korea reported a 24% reduction in MetS risk among individuals with the highest score of the healthy dietary pattern compared to those with the lowest score [19]. A prospective study has also reported an association between the metabolic syndrome and dietary pattern [20]. The mechanisms of the inverse association between higher scores of traditional dietary pattern and the metabolic syndrome are not fully understood, but may be attributed to a higher content of whole grain, fiber, fruit and vegetables in this dietary pattern and thus higher intakes of micronutrients. It is known that high carbohydrate diets have detrimental effects on metabolic syndrome parameters including HDL-C, TG and glucose homeostasis [21, 22] whereas consumption of dairy products and nuts (components of traditional dietary pattern) were inversely associated with waist circumference [21-24]. The most important limitation of this study was few numbers of female participants.

Conclusion

In conclusion, the current finding encourages a traditional dietary pattern with high content of nuts, fruit, vegetables, whole grain and low fat dairy products for the prevention of MetS and other metabolic disorders according to the significant association between such a diet and MetS.

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Conflict of interest

None of authors have conflict of interest.

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