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Original Article

Gender and Age Discrepancies of Lifestyle Indices Related to Metabolic Syndrome among Iranian Aging Population

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Abstract

Background: We aimed to investigate the relationship between lifestyle status and metabolic syndrome (MetS) components across gender and age groups of the older population, specifically focusing on identifying the association between MetS and lifestyle factors in classified age groups in older individuals.

Methods: Overall, 582 older people with MetS in Yazd (Iran) urban primary health care centers were randomly included from 10 health centers and invited to participate in the study in 2022. During the phone invitation, eligible interested people were asked to refer to health care centers for clinical assessments by trained health researchers. MetS components, dietary intakes using validated frequency food questionnaire, and physical activity by International physical activity questionnaire (IPAQ-short form) were measured.

Results: Women with Mets under 75 yr had significantly higher BMI, weight, and FBS than men and men had significantly higher WC than women. Among patients over 75 yr old, women had significantly higher weight than men had and lower WC and lower HDL_C than men. There were significant differences between gender groups of the aging patient under 75 yr old in terms of vigorous physical activity, total metabolic equivalent of activity, total fat intake, PUFA, and sodium intake, with men reporting level of mentioned lifestyle factors than women.

Conclusion: There were significant gender differences between two aged groups (>75 and <75 yr old) of patients for MetS components and lifestyle risk factors. Weight and WC showed noteworthy gender differences, with variations in both age groups.

Keywords: Metabolic syndrome; Dietary intake; Physical activity; Aging people

Introduction

The WHO estimated that the number of elderly people in the world will increase from 1.2 billion in 2025 to more than 2 billion by 2050 (1). The elderly population is also increasing in Iran,

which has one of the fastest growth rates of the elderly population in the world (2), besides, proportion of the elderly population in this country underwent a significant increase, rising from 7.22% in 2006 to 20.8% in 2011. By 2050, it is estimated that the Iranian population aged 65 and over will experience a substantial increase of 21.7% (3).

As the population continues to age, the elderly is facing higher rates of chronic diseases and metabolic disorders, encompassing cardiometabolic conditions such as cardiovascular diseases (CVDs), stroke, and diabetes, along with their primary risk factors. CVDs increase mortality and all-cause mortality especially among the elderly individuals (4). Metabolic Syndrome (MetS) is more common among older people than other age groups (5). Several definitions have been presented by the WHO, the International Diabetes Federation (IDF), the American Heart Association (AHA), and the National Heart, Lung, and Blood Institute (NHLBI) for the diagnosis of metabolic syndrome (6). In this regard, the criterion provided by the adult treatment panel (ATP III) has more applicable in clinical assessments. According to the ATP III definition, a cluster of metabolic abnormalities including abdominal obesity, elevated blood pressure (BP), elevated blood glucose, low high-density lipoprotein cholesterol (HDL-C), and elevated triglyceride (TG) (7-9). The prevalence of MetS has been increasing worldwide. It varies from 12% to 37% among Asian population and among European societies 12% to 26% (10-12). Iran has one of the highest rates of the prevalence of the MetS. The results of Lipid and Glucose study among adult population in Tehran revealed that MetS appears to affect 33.7% among the general population (42% in women and 24% in men) (8).

The pathogenesis of MetS is complex and influenced by multiple factors, and the precise underlying cause of MetS remains incompletely understood. Poor lifestyle habits, unhealthy diet, inactivity, and obesity are the main risk factors for MetS (13).

Lifestyle modification strategies, which primarily involve adopting regular physical activity and making dietary changes, play a crucial role in the management of MetS. Healthy lifestyle is defined as regular physical activity, not smoking, having healthy dietary patterns, and avoiding obesity (14-16).

Moderate physical activity such as regular walking can reduce risk of cardiovascular diseases and prevent metabolic syndrome (17). In a cohort study in Iran, greater adherence to healthy lifestyle was associated with a reduced risk of six-year incidence of MetS (18). Various studies have been conducted to identify the relationship between nutrition and different components of MetS (19-21). There are a few studies in the field of identifying the role of diet and physical activity status in the occurrence of metabolic syndrome among elderly populations. The elderly women suffering from metabolic syndrome with a western food pattern had less physical activity (21).

Unhealthy diet such as increasing consumption of a contemporary high-fat diet, carbonated soft drinks, meat, fast food, and processed foods and reducing the consumption of fiber-rich foods have increased the development of components of the metabolic syndrome within the population (22).

Given the elevated prevalence of metabolic syndrome among the elderly population in Iran and the limited availability of information on this topic, there is a potential correlation between the level of physical activity, dietary intake, and the occurrence of metabolic syndrome.

We aimed to investigate the relationship between lifestyle status and metabolic syndrome components across gender groups and different age groups of the older population, specifically focusing on identifying the association between metabolic syndrome and lifestyle factors in classified age groups in older individuals.

Methods

Study design and setting

This cross-sectional study was conducted during the first semester of 2022 in Yazd, Iran. Yazd is a

city located in central Iran with an estimated urban population of 563,076 people and aging urban population (60 yr and over) of 77,625 people (23). There are 28 health centers in Yazd and 10 health centers were randomly selected among them. In each center, the integrated electronic health system (SIB) provides access to all the health information of the participants. As such, all individuals' health records were available in the health centers. The main researcher (AD) extracted the list of people 60 yr and over using the SIB system. The participants were randomly selected using the online software (www.random.org) and the process was continued until the sample size was obtained.

Participants

Overall, 734 older people in Yazd urban primary health care centers were randomly recruited and invited to participate in the study. During the phone invitation, eligible interested people were asked to refer to health care centers for clinical assessments by trained health researcher. In total 986 aging individuals for MetS were invited and 582 people were included the study. The inclusion criteria were a) having ages 60 yr and over, b) living in Yazd city, C) having interest to participate in the study. Exclusion criteria were a) having diagnosed cognitive disorders, b) following special lifestyle, c) having movement restriction.

Sample size was calculated according to the results of the Yazd People's Health Study (PHS). The sample size was determined at 582 people with MetS by assuming a 52.3% prevalence of metabolic syndrome among the elderly in Yazd City and with d=0.07 and 95% confidence level of 1.5.

Measurements

Data were collected using three questionnaires. A short questionnaire collected demographic data related to age, gender, marital status (single, married, divorced or widowed), educational qualification (illiterate, primary and secondary education, university degree), income level, and religious (Muslim and Zoroastrian). MetS was defined based on the national cholesterol education program (NCEP) adult treatment panel (ATP III) as the presence of three or more criteria of five metabolic syndrome criteria except for waist circumference determined as≥ 90 cm for both genders for Iranian aging population (24); Systolic/diastolic blood pressure 130/85 mmHg or higher, fasting blood glucose level 100 mg/dl or higher, triglycerides level<150 mg/ dl, and HDL level<40 mg/dl in men and <50 mg/dl in women.

Anthropometric measurements were performed by an expert researcher. Blood pressure was measured by using a digital arm sphygmomanometer (made by Omron, model 7 M from Vietnam) after at least 10 min of rest, sitting and measuring it from the dominant hand of the participant in two stages with an interval of 5 min, and recording their mean. Blood sampling was done by three ml of brachial vein blood for person in a recommended fasting for 10-12 hour. Weight was measured with minimum clothes and without shoes with an accuracy of 0.1 kg using a digital scale made in Germany (DLT-411 model). The body mass index was calculated by dividing the person's weight in kilograms by the square of height in meters. Waist circumference was measured at the midpoint between the iliac blade and the lowest expiratory rib using an inflexible tape meter (25).

Physical activity assessment

A short form of the International PA Questionnaire (IPAQ-SF) was used to assess PA levels (26). The validity and reliability of IPAQ-SF was well documented previously among Iranian population. The IPAQ items in the four categories of vigorous activity, moderate activity, walking, and sitting time. The IPAQ data were converted to metabolic equivalent scores (MET-min/week). For estimating PA (MET-min/week) for each type of activity, the following values were used: vigorous PA=8.0 METs, moderate PA=4.0 METs, and walking=3.3(27).

Dietary intake measurements

Data on dietary intake were collected using a validated semi-quantitative food frequency ques-

tionnaire (FFQ) that included 50 food items for a year (28). Participants were asked to select how many servings and frequencies of each food they used during last six months.

Statistical Analysis

Normality of data was assessed by Kolmogorov-Smirnov test. Continuous and discrete variables are presented with mean and standard deviation, number and percentage, respectively. Chi-square analyses were used to test the difference between biochemical variables between two groups. Multiple logistic regressions analysis was used to examine the associations between risk factors of MetS and socio demographic factors as independent and dependent variables, respectively. Adjusted odds ratio and 95% confidence intervals were calculated for all metabolic syndrome parameters. Statistical analyses were performed with SPSS 22 for windows (IBM Corp., Armonk, NY, USA). *P* values less than 0.05 were regarded as statistically significant.

Ethical approval

Informed written consent was obtained from all participants. All methods were performed in accordance with the relevant guidelines and regulations. The study received ethical approval from the Ethics Committee of Tabriz University of Medical Sciences (No.: IR.TBZMED.REC.1403.088).

Results

Overall, 570 elderly individuals aged 60–91 participated in study (not completed questionnaire n=12). The Mean (SD) age was 72.71 (5.57) yr. The majority of the participants were women (55%), married (72.9%), Muslim (91.8%) and illiterate (46.4%). The general characteristics of the study participants are presented in Table 1.

Table 1: Baseline characteristics of the study participants with metabolic syndrome based on ATP III definition

Variable	***Aged 60-74 (n-404)***				***Aged ≥75 (n=166)***				
	Men	Women	Total	*P*-value	Men	Women	Total	*P*-value	*P*-value
Marital status									
Married	153(90.5)	156(63.2)	309(74.3)	<0.001	80(86.0)	35 (47.9)	115(69.3)	<0.001	<0.001
Single	4(2.4)	0	4 (1)		0	0	0		
Widowed/divorced	12(7.1)	91(36.8)	98(23.6)		13(14.0)	38(52.1 %)	51(30.7 %)		
Education									
Illiterate	33(19.5)	95 (38.5)	128(30.8)	<0.001	22(23.7)	43 (58.9)	65(39.2 %)	<0.001	<0.001
Primary education	79(46.7)	132 (49.8)	202(48.6)		40(43.0)	28 (38.4)	68(41.0)		
Secondary and higher education	57(33.8)	29 (11.9)	86(20.6)		31(33.4)	2 (2.7)	33 (19.8)		
Religious									
Muslim	157(92.9)	232(93.9)	389(93.5)	0.676	79(84.9)	66(90.4)	14(87.3)	0.293	<0.001
Zoroastrian	12(7.1)	15(6.1)	27(6.5)		14(15.1)	7 (9.6)	21(12.7)		

Table 2 presents the components of metabolic syndrome for individuals under 75 yr old and over 75 yr old. Women with Mets under 75 yr had significantly higher BMI (29.29 [4.62] VS 27.68 [3.8], weight (76.8 [11.75] VS 70.45 [11.1]), FBS (175.47 [48.59] VS 149.95 [45.33]) than men and men had significantly higher WC (101.01 [9.93] VS 99.61 [10.77] than women.

Table 2: Gender difference of metabolic syndrome risk factors among aging people under 75 and over 75 yr old

	Aged 60-74				***Aged≥ 75***				
Variable	Men	Women	Total mean	*P*-value	Men	Women	Total mean	*P*-value	*P*-value*
BMI (kg/m²)	27.68 (3.80)	29.29 (4.62)	28.63(4.37)	<0.001	26.80(3.84)	26.97(4.50)	26.87(4.13)	0.798	<0.001
Weight (kg)	70.45(11.10)	76.81 (11.75)	73.04(11.78)	<0.001	62.65 (11.95)	72.87(10.87)	68.37(12.53)	<0.001	<0.001
WC (cm)	101.02(9.93)	99.61 (10.77)	100.18 (10.44)	0.037	101.18 (9.88)	96.33(12.14)	99.05(11.16)	0.005	0.247
SBP (mmHg)	150.26 (14.12)	148.34 (15.95)	149.12(15.24)	0.034	148.34 (14.64)	145.88(15.09)	147.26(14.85)	0.289	0. 181
DBP (mmHg)	85.08(6.19)	85.02 (6.18)	85.04(6.17)	0.088	85.49 (6.22)	85.37(5.74)	85.44(6.00)	0.895	0.476
CHO (mg/dl)	199.67(38.90)	207.11 (44.23)	204.09(42.26)	0.098	198.62 (41.28)	207.9(40.91)	202.7(41.25)	0.151	0.720
HDL-C (mg/dl)	37.76(9.41)	37.96 (11.33)	37.88(10.58)	0.064	38.75 (8.56)	35.70(10.17)	37.41(9.40)	0.037	0.618
TGs (mg/dl)	210.52(64.71)	211.44 (54.98)	211.07(59.05)	0.096	207.47 (55.55)	209.44(57.87)	208.34(56.42)	0.825	0.610
FBS (mg/dl)	149.95(45.33)	175.47 (48.59)	154.41(47.38)	0.037	143.95 (37.00)	145.7 (31.23)	144.72(34.49)	0.746	0.017

**P* values derived from t-test on comparison of ages 60-74 and ≥ 75

Table 3 presents an overview of physical activity status, dietary energy and nutrient consumption of aging people in two different age (under 75 and over 75 yr) and gender groups. There were significant differences between gender groups of the aging patient under 75 yr old in terms of vigorous physical activity, total metabolic equivalent of activity, total fat intake, PUFA, and sodium intake, with men reporting level of mentioned lifestyle factors than women. Among aging patient over 75 yr old, men had significant vigorous physical activity and total metabolic equivalent of activity than women while women had higher walking level than men. In addition, there were significant differences between two age groups of patients based on all the measured physical activity and dietary intake variables, except walking.

Table 3: Physical activity and dietary intakes among two groups of aging population

Variable	*Aged 60-74 yr*				*Aged ≥75 yr*				
	Men (Mean, s.d.)	Women (mean, s.d.)	*P*-value	Total	Men (Mean, s.d.)	Women (mean, s.d.)	*P*-value	Total	**P*-value
Physical activity MET-min per week									
Vigorous	994.01(134.70)	363.11(68.47)	<0.001	619.41(69.75)	243.44(93.94)	9.86(9.863)	0.030	140.72(53.45)	<0.001
Moderate	1236.40(99.86)	980.45 (70.76)	0.32	1084.43 (58.65)	389.89 (82.96)	266.95 (71.61)	0. 279	335.8356.18)	<0.001
Walking	463.82(36.12)	462.99(28.45)	0.985	463.33 (22.35)	551.61 (58.91)	380.86 (52.13)	0.037	476.52(40.615)	.763
Total metabolic equivalent of activity	3105.55(193.02)	2232.92(118.29)	<0.001	2587.42(107.21)	1646.35(171.63)	1111.36(92.89)	0.012	1411.08(106.23)	<0.001
Dietary intake									
Total calories (kcal/d)	5909.09(69.30)	5780.60(63.47)	0.181	5832.8(960.47)	6260.91 (883.19)	6818.88 (105.57)	<0.001	6506.29(932.28)	<0.001
Total fat (mg) per day)	205.33(3.06)	197.14 (2.23)	0.028	200.47(37.30)	217.73 (47.12)	235.46 (45.69)	0.016	225.53 (47.19)	<0.001
Cholesterol (mg/d)	897.32(22.49)	942.94 (26.31)	0.217	924.41(369.44)	1964.82 (1883.79)	3017.00 (2022.70)	0.001	2427.52 (2009.57)	<0.001
SFA(g/d)	63.82(1.27)	61.32(0.928)	0.104	62.33(15.46)	66.53 (16.22)	71.90(15.91)	0.034	68.89(16.26)	<0.001
PUFA (g/d)	32.95(0.525)	31.08(0.482)	0.010	31.84|(7.33)	35.67 (6.19)	38.25(6.32)	0.009	36.80(6.36)	<0.001
MUFA	59.53(10.8)	59.11(10.60)	0.696	59.30(10.68)	68.62 (17.04)	77.35(18.75)	0.002	73.46(18.47)	<0.001
Protein (g/d)	232.21(2.85)	225.28(2.85)	0.098	228.10(42.00)	263.17(52.14)	292.12(51.98)	<0.001	275.9(53.87)	<0.001
Carbohydrate (g/d)	814.92 (10.68)	804.58 (10.45)	0.503	808.78 (154.46)	848.64 (107.76)	926.08 (118.30)	<0.001	882.70(118.61)	<0.001
Fiber (g/d)	97.25 (1.53)	93.37 (1.43)	0.072	94.95 (21.60)	100.98 (18.66)	107.13 (21.40)	0.050	103.68(20.09)	<0.001
Sodium (mmol/d)	8859.48 (124.95)	9321.55 (130.79)	0.011	9133.84 (1903.87)	10090.12 (1749.55)	10840.57(1931.11)	0.011	10420.14 (1863.75)	<0.001

SFA Saturated fatty acids, MUFA Mono-unsaturated fatty acids, PUFA Polyunsaturated fatty acids.

Discussion

This cross-sectional study aimed to investigate gender and age differences of metabolic syndrome and its determinants among the aging population. The majority of the study participants was married, Muslim and illiterate (46.4%). There were age and gender differences of metabolic syndrome and lifestyle risk factors between age and gender groups of the aging patient with MetS. Based on the comparison of two age groups of patients with metabolic syndrome, patient over 75 yr old had significantly lower BMI, weight, and FBS than patient under 75 yr old. Other investigations have showed age differences in metabolic syndrome components especially for FBS and WC. Although aging patients experience higher levels of metabolic syndrome risk factors, after 75 yr old, the average range of FBS as one of the MetS component

were lower than other age group. Lower level of glycemic is commonly observed among older people over the age of 75 yr (29). Lower glycemic levels, lower weight, and BMI can be interpreted in frailty. Frailty is a condition characterized by decreased strength, endurance, and physiological reserve that may contribute to this phenomenon (30). Frailty often leads to reduced physical activity and muscle mass, which can affect glucose metabolism and insulin sensitivity (31). It is important for healthcare providers to be aware of these changes in older patients, as it can impact their management of risk factors or other conditions related to glucose metabolism. Regular monitoring and individualized care are essential to address the unique challenges faced by older adults in maintaining their overall health, especially about metabolic factors like glycemic control.

Indeed, we found that older patients over 75 yr old had significantly less physical activity than another group. Older individuals may face limitations in engaging in physical activity. The body's natural adaptive mechanisms and age-related alterations may contribute to the reduction in metabolic syndrome risk factors among the elderly population. Even after age 75, it remains crucial for older adults to maintain a healthy lifestyle and continue monitoring their health to minimize the risk of metabolic syndrome and its potential complications.

There were significant gender differences between two aged groups (>75 and <75 yr old) of patients for metabolic syndrome components and lifestyle risk factors. According to our results, weight and WC showed noteworthy gender differences, with variations in both age groups. In addition, the total MET, reflecting overall physical activity, displayed significant gender discrepancies in both age groups, potentially suggesting differences in activity levels between men and women. Similar differences were observed for dietary risk factors including total fat, PUFA, and sodium intake (31). In a study, men with a normal body weight, engaged in vigorous physical activity, rarely consumed salt and fat, and regularly consumed appropriate amounts of protein tended not to develop metabolic syndrome. Women with a healthy metabolism typically had a normal body weight and frequently consumed dairy products (32). Moreover, women under 75 yr old had significantly higher mean level of BMI, weight, SBP, DBP, FBS, CHO and TG and men had significantly higher mean levels of WC and HDL. These results were consistent with the results of other studies (32). The studies from India and Iran identified increasing age and female gender as independent risk factors for metabolic syndrome (33, 5).

The main reason of lack of activity 75 ≥ related to existence various physical, psychological, cognitive and environmental conditions, including joint inflammation, osteoporosis, hip fracture, stroke and Parkinson's disease, lack of motivation, and family barriers (34). The fear of falling is one of the reasons for the low level of physical activity of the elderly over 75 year (35). There is a gender difference in choosing the type of physical activity in American's adults (36). Moderate physical activity such as regular walking can reduce cardiovascular diseases and prevent type 2 diabetes and metabolic syndrome (17, 37).

As a limitation of the study, cross-sectional design of this study could not support us to assert strong associations observed in this study.

Conclusion

There were age and gender differences of metabolic syndrome and lifestyle risk factors between age and gender groups of the aging patient with MetS. Based on the comparison of two age groups of patients with metabolic syndrome, patient over 75 yr old had significantly lower BMI, weight, and FBS than patient under 75 yr old. There were significant gender differences among two aged groups (>75 and <75 yr old) of patients for metabolic syndrome components and lifestyle risk factors. According to our results, weight and WC showed noteworthy gender differences, with variations in both age groups.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that they have no competing interest.

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