Original article

# Metabolic syndrome and its risk factors among middle aged population of Iran, a population based study

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A B S T R A C T

*Aims:* To determine the prevalence of metabolic syndrome (MS) and its risk factors in a middle-aged population in Iran.
*Methods:* The sample was 5190 individuals aged 40–64 years participated in the first phase of the Shahroud eye cohort study. Prevalence of MS was determined in terms of the age and sex. Other variables were evaluated by using simple and multiple logistic regression methods.
*Results:* The prevalence of MS was 10.88% in men, 13.03% in women and 12.14% in total. The prevalence proportion increased with increasing age. In multivariate logistic regression model, age (odds ratio (OR) = 1.06), education (OR = 0.98) and smoking (OR = 0.50), had significant effects on MS. In this model, gender, marital status and economic status had no significant effect on MS. Higher prevalence of obesity and overweight in non-smokers (79.9%) compare to smokers (47.4%, $P < 0.001$), indicated that the association of smoking and MS is confounded.
*Conclusions:* Despite the low prevalence of MS in this study, older age was associated with increased risk of developing MS and higher education was associated with decreased this risk, therefore health education, changing the lifestyle, and taking greater attention in elderly is needed in order to prevent the MS and its complications.

## 1. Introduction

Metabolic syndrome (MS) is a group of interrelated risk factors with metabolic origin which seems to be directly led to the development of atherosclerotic heart disease and type 2 diabetes [1]. This syndrome includes obesity, hypertension, impaired glucose tolerance, high triglycerides and low high-density lipoprotein (HDL), and its prevalence is rapidly increasing in the world [2]. There are several definitions for the MS. According to these definitions, for the diagnosis of MS, the patient should have at least three factors of cardiovascular risk factors, simultaneously [3]. After the emergence of strong evidence to support the role of central obesity as the main cause of MS, and regarding significant ethnic differences in the definition of obesity, World Diabetes Federation proposed another

set of criteria for the diagnosis of MS to highlighting the role of central obesity and ethnic differences [4].

Currently this combination of MS is a major challenge for global health; because people involved in cardio-metabolic risk are also at the risk of developing cardiovascular disease and diabetes [5,6] which is considered as one of the major worldwide health problems [7]. In both Western and Asian populations, cardiovascular morbidity and mortality is two to five times higher in those who are suffering from this syndrome than those who are not affected by MS [8]. The prevalence of MS has been reported in various countries differently. The prevalence of this disorder among adults was equal to 38.5% in the United States [9], 21.1% in France [10], 54.8% in Mexico [11], 35.73% in Morocco [2], 21.3–39% in China [12,13], 21% in Saudi Arabia [14], 33.5% in Turkey [15], and 21.9–32% in different regions of Iran [16–23].

Previous studies suggest that MS can be influenced by different factors. For example, in the study of Xi et al. [12] female gender, aging, overweight or obesity, and urbanization were reported as

predictors of MS. In the study conducted by El Brini et al., MS in females was increased with aging and abdominal obesity [2]. However, based on the studies conducted by Cheserek et al. and Johnson et al., the risk of MS is higher in men than in women [24,25]. In a study conducted in Ghana, smoking and alcohol consumption were associated with an increased risk of MS [26]. Also, in the study of Moreira et al., the prevalence of MS among elderly, or those with a higher body mass index, as well as among low-literate people was increased [27].

In the studies conducted in Iran, variables such as female gender, increasing age, low literacy and inactivity were associated with the increased risk of the MS [28]. Although in the study conducted by Rashidi et al., the variables such as age, sex and BMI were reported as factors affecting the risk of MS, but the prevalence of the MS was lower in women than men [29]. Considering what was above mentioned and according to the difference between the results of some studies conducted about the risk factors for MS, and increasing prevalence of non-communicable diseases in recent years, as well as considering the fact that current estimates of the prevalence of MS in Iran – in the form of non-communicable diseases surveillance system – have been conducted with a sample size that is suitable for the whole country and does not identify related risk factors, this study aimed at better understanding the prevalence of MS and its related risk factors in the middle-age population.

## 2. Methods

The sample was 5190 individuals aged 40–64 years participated in the first phase of the Shahroud eye cohort study, conducted in 2009. The methodology of study has been reported in detail previously [30]. In summary 300 clusters from Shahroud, north-eastern Iran, were randomly selected using the stratified cluster sampling method in nine strata. Health care centers were considered as the strata. From each cluster, at least 20 individuals aged 40–64 years were selected and invited to participate. All participants complete a thorough eye examination, blood sample, height, weight and blood pressure measurements and interview about demographic and visual risk factors including systemic diseases. After receiving explanation of the study aims and methods, participants signed a written informed consent. The study protocol was reviewed and approved by the ethics committee of the Shahroud University of Medical Sciences, which was conducted in accord with the tenets of the declaration of Helsinki.

In this study, definition of MS was based on the American Association of Clinical Endocrinologists (AACE) diagnostic criteria. Individuals with non-fasting blood glucose greater than or equal to 140 mg/dl or having history of diabetes or using hypoglycemic medications, having blood pressure greater than or equal to 130/85 mm/Hg or using anti-hypertension drugs and a body mass index greater than or equal to 25 were considered as those with the MS [31].

The blood pressure of the right arm, in the sitting position after 5 min rest was measured by a trained nurse using an electronic sphygmomanometer. It was measured at two consecutive times with an interval of 3 min. After two measurements, if the differences between the values obtained were greater than 10 mm/Hg in systolic blood pressure and/or 5 mm/Hg in diastolic blood pressure, the measurement is performed for the third time. Then, those two measurements that are closer together are selected. The mean systolic and diastolic blood pressure in these two measurements was considered as the systolic and diastolic blood pressure. BMI was calculated by dividing weight (in kilograms) by height squared (in meters). Economic status of individuals was calculated by using principal component analysis on the home assets, and participants were classified into three groups of people with high, middle and low economic status.

**Table 1**
Prevalence of MS according to age groups and gender in Shahroud, Iran; 2009.

| Age groups | Male (n = 2151) | Female (n = 3039) | Total (n = 5190) |
|---|---|---|---|
| | % (CI 95%) | % (CI 95%) | % (CI 95%) |
| 40–44 | 6.91 (4.24–9.60) | 6.33 (4.47–8.19) | 6.52 (4.99–8.06) |
| 45–49 | 9.38 (6.85–11.90) | 8.86 (7.02–10.71) | 9.06 (7.66–10.47) |
| 50–54 | 7.30 (5.30–9.32) | 15.56 (12.95–18.18) | 11.96 (10.26–13.65) |
| 55–59 | 15.38 (12.00–18.77) | 19.49 (16.16–22.82) | 17.5 (15.30–19.86) |
| 60–64 | 18.25 (13.52–22.97) | 21.43 (16.09–26.77) | 19.93 (16.28–23.59) |
| Total | 10.88 (9.47–12.29) | 13.03 (11.81–14.25) | 12.14 (11.24–13.04) |

CI, confidence intervals.

Prevalence of MS in different age and sex groups was presented with 95% confidence interval (CI). The role of other variables on the MS was examined by using simple and multiple logistic regression methods. For all tests, the significance level was considered to be equal to 0.05, and the effect of cluster sampling was considered in the calculation of CI.

## 3. Results

Based on the above definition, 12.14% (CI 95%, 11.24–13.04) of participants had MS. This proportion was equal to 10.88% (CI 95%, 9.47–12.29) in men and 13.03% (CI 95%, 11.81–14.25) in women. Further description of this disease in terms of the age and sex groups is shown in Table 1.

Table 2 shows the role of independent variables on MS. In the simple regression model, age, sex, education, smoking, and economic status showed a significant relationship with the outcome. In this model, marital status had no association with MS. In multivariate logistic regression model, after removing variables that had no significant effect on the outcome, age (odds ratio (OR) = 1.06) had positive effect on MS, and smoking (OR = 0.50) and education (OR = 0.98) reduced the risk of MS.

## 4. Discussion

Based on the results, the prevalence of MS in the 64–40 years Iranian peoples was 12.14%. Other studies conducted in Iran and other parts of the world reported a higher prevalence for MS. The prevalence of this disorder among adults was 38.5% in the United States [9], 27.8% in Spain [32], 21.1% in France [10], 25.9% in Norway [33], 54.8% in Mexico [11], 35.73% in Morocco [2], 30% in Tanzania [34], 25% in Korea [35], 21.3–39% in China [12,13], 40–50% in India [36], 21% in Saudi Arabia [14], 36.3% in Jordan [37], 33.5% in Turkey [15], and 21.9–32% in different regions of Iran [16–23]. Possible reasons for this difference and lower prevalence of MS, are racial and regional differences, age differences between studies, and the use of different definitions for MS. It should be noted that in this study, there was no access to IFG or IGT and those with non-fasting blood glucose greater than or equal to 140, or those who use anti diabetic medication were considered as individuals with insulin resistance.

In this study, the prevalence of MS in women (13.03%) was higher than in men (10.88%). Although simple logistic regression analysis showed that this difference is significant, multivariate logistic regression results showed that this difference is not significant in the presence of other variables such as age. In various studies conducted in Iran and other parts of the world, the prevalence of MS in both sexes is different. In some studies, the prevalence of this syndrome has been reported in women higher than in men [2,12,19,21,28], which is consistent with the results of the present study. However, in some studies, the prevalence of MS was higher in men than in women [24,25,29].