

# A Review on Metabolic Syndrome

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## Abstract

The metabolic syndrome is described by the clustering of several risk factors for Type 2 diabetes and cardiovascular disease. Lipid disorder, obesity, diabetes in general and high blood pressure are collectively defined as risk factors for cardiovascular disease triggered by metabolic syndrome. The metabolic syndromes have a correlation with the variations in genetic susceptibility, nutritional regimen, physical exercise, chronological age and gender which play direct role in the incidence of metabolic syndrome and its side effects. There are several definitions of Metabolic Syndrome in the World: World Health Organization's (WHO), The NCEP Adult Treatment Panel (ATP) III and the International Diabetes Federation (IDF). It appears that the female type 2 diabetic patients need to change their life style to halt the burden of cardiovascular complications in type 2 diabetic patients. Clinicians should significantly consider screening all people regardless of age for abnormalities in glucose level. Early treatment in people with abnormal glucose level constitutes a strategy of preventing type 2 diabetes mellitus and metabolic syndrome. Studies about metabolic syndrome have shown that females were more affected than males. This may be due to the specific characteristics in the lifestyle changes between females and males diabetic patients. Postmenopausal status might be a predictor of metabolic syndrome. Some related factors of metabolic syndrome among postmenopausal women may increase cardiovascular risk in postmenopausal women.

**Keywords:** Metabolic syndrome; Type 2 diabetes mellitus; Postmenopausal women

## Introduction

The metabolic syndrome (MetS) is described by the cluster-

ing of several risk factors for cardiovascular disease (CVD) such as hypertension, dyslipidaemia, obesity (particularly central obesity), insulin resistance and high fasting plasma glucose [1]. In 2001, The Third Report of National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (ATP III) emphasized the importance of the metabolic syndrome and provided a working definition of this syndrome for the first time [2]. Differences in genetic background, diet, levels of physical activity, age and sex structure all influence the prevalence of both metabolic syndrome and its components [3]. Cardiovascular disease is one of the main reasons of death among women in the world [4]. Gerald Reaven emphasized correlation of metabolic syndrome with cardiovascular risk factors such as abnormally high blood pressure, lack of glucose tolerance, hyper-triglyceridemia and low level of high density lipoprotein (HDL) [5]. In 1998, World Health Organization suggested for the above syndrome to be named it the 'metabolic syndrome' [6]. Statistically, the incidence of metabolic syndrome is reported to be about 8 to 24.2% [7-8] and 7 to 46.5% [9-10] in men and women respectively. Studies in Iran showed that prevalence of the metabolic syndrome was 35-58% [11-12]. There are many reports in the literature supporting; in which metabolic syndrome as valuable index for vascular disease among general populations [13-15]. There is increasing prevalence of the metabolic syndrome whole around the world. Many studies have been done to determine the prevalence of diabetes mellitus worldwide and few have been done to determine the prevalence of metabolic syndrome. People with metabolic syndrome are at increased risk for developing diabetes mellitus and cardiovascular disease, as well as increased mortality from cardiovascular disease. Lipid disorder, obesity, diabetes in general and high blood pressure are collectively defined as risk factors for cardiovascular disease triggered by metabolic syndrome [16]. Incidence of metabolic syndrome increases as age progresses. In a study in Turkey, the prevalence of the metabolic syndrome was 15.3%, 23.1%, 28.0%, 26.0%, and 20.5% among people aged from 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79 and  $\geq 80$  years old, respectively [17]. Study in Norway showed that prevalence of the metabolic syndrome elevated with age

Manuscript accepted for publication July 20, 2012

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doi: <http://dx.doi.org/10.4021/jem118e>

into the ninth decade of life [18]. Study of Ford showed that the prevalence of the metabolic syndrome was 16.5%, 40.3%, and 46.4% for males, and 19.1%, 33.8%, and 56.0%, respectively, for females among US people aged from 20 to 39, 40 to 59 and  $\geq 60$  years old, respectively. There was an association between older age groups and a higher prevalence of metabolic syndrome [19]. Park et al showed that there was an increase in prevalence of the metabolic syndrome from 20 years old through the sixth and seventh decade of life for males and females, respectively. World Health organization predicts the prevalence of obesity to be 4.8%, 17.1% and 20% in less developed, developing and developed countries, respectively [20]. As reported in the year 1991, 53% males and 44% females were obese in United Kingdom [21]. Cardiovascular disease is one of the main reasons of death among women in the world [4]. Studies indicated that women aged more than 55 have a higher incidence of cardiovascular disease than younger women [8, 22-23]. Other studies showed that there is a high prevalence of metabolic syndrome among postmenopausal women, which varies from 32.6% to 41.5 % [24-26]. Study of Rossi et al [27] demonstrated that postmenopausal women with metabolic syndrome have lower incidence of cardiovascular risk factors. The mechanism behind the role of menopausal risk factors in initiating cardiovascular disease remains unclear [28]. Some studies have been shown that there is no difference in cardiovascular risk factors when comparing pre-menopausal with postmenopausal women [29-32]. In several studies, the incidences of metabolic syndrome among postmenopausal women were found to be increased in the world [33]. Our interest in present study was to explain the state of metabolic syndrome. In this study, it was reviewed with a number of related articles on metabolic syndrome.

## Definition of Metabolic Syndrome

There are several definitions of Metabolic Syndrome in the World. World Health Organization's (WHO) made a decision in 1988 to standardize the criteria. The WHO was defined as one of the following: Type 2 diabetes impaired fasting glucose, impaired glucose tolerance and for those with normal fasting glucose ( $< 110$  mg/dL). The risk factors include antihypertensive medication and or high blood pressure ( $\geq 140$  mmHg systolic or  $\geq 90$  mmHg diastolic), plasma triglycerides  $\geq 150$  mg/dL, HDL cholesterol  $< 35$  mg/dL in men or  $< 39$  mg/dL in women, BMI  $> 30$  kg/m<sup>2</sup> and or waist: hip ratio  $> 0.9$  in men and  $> 0.85$  in women [34]. In 2001, the National Cholesterol Education Program (NCEP) introduced the concept of Metabolic Syndrome. The NCEP Adult Treatment Panel (ATP) III criteria somewhat overlaps the WHO criteria and a diagnosis is based on having at least three out of five of the following: waist circumference  $> 40$  inches in men or  $> 35$  inches in women, triglycerides  $\geq 150$  mg/dL, HDL

cholesterol  $< 50$  mg/dL in women and  $< 40$  mg/dL in men, blood pressure  $\geq 135/85$  mmHg and fasting serum glucose of  $\geq 110$  mg/dL [2]. In 2005, the International Diabetes Federation (IDF) suggested a definition of Metabolic Syndrome and represents modifications to the WHO definition and ATP III criteria. According to the IDF definition, an individual is diagnosed as having Metabolic Syndrome if they have central obesity (waist circumference of  $\geq 94$  cm for men and  $\geq 80$  cm for women) and any two of the following factors: elevated triglycerides ( $\geq 150$  mg/dL), decreased HDL cholesterol ( $< 40$  mg/dL) in males and  $< 50$  mg/dL in females), hypertension (systolic  $\geq 130$  mmHg or diastolic  $\geq 85$  mmHg) and raised fasting plasma glucose ( $\geq 100$  mg/dL) [35].

## Different Views

Differences in genetic background, diet, levels of physical activity, age and sex structure all influence the prevalence of both metabolic syndrome and its components [3]. The prevalence of metabolic syndrome (using the WHO definition) in Ireland was 21%. The prevalence was higher in males (24.6%) than in females (17.8%) [14]. From the available data from "the Botnia study" (using the WHO definition) and involving families of Finland and Sweden descent, the prevalence was 84% and 78% in male and female subjects with type-2 diabetes, respectively [16].

In the United States, the prevalence of metabolic syndrome was 21.8% using the ATP III definition [8]. Mexican Americans had the highest prevalence of metabolic syndrome (31.9%). The prevalence was similar for male (24.0%) and female (23.4%) subjects. The prevalence in Isfahan (Iran) was 65.0% with higher rate in females than males (71.7% female and 55.8% male) [36]. The prevalence in Karachi (Pakistan) was 79.7% in type 2 diabetics, (45.5% females and 34.3% males) [37]. The overall prevalence of metabolic syndrome in Japanese type 2 diabetic patients was 168 (26.37%) out of 637 type 2 diabetic patients. The prevalence was higher in males (45.9%) than females (28.0%) [38]. A study done in Korean estimates the overall prevalence was 32.6%. The prevalence was found to be 46.9% and 65.1% among males and females respectively [39]. The overall prevalence among Saudis with type 2 diabetes was 22.64% (19.49% male, 25.17% female) [40]. Study of Marjani et al showed that the prevalence of metabolic syndrome in type 2 diabetic patients is higher in females (53.27%) than males (48.71%), and that the prevalence of metabolic syndrome in Gorgan is appreciably higher compared with that in some other countries [41].

Study on postmenopausal women in Austria showed that the prevalence of metabolic syndrome was 32.6% [26]. In another study on postmenopausal women in Chengdu, China, the prevalence of metabolic syndrome was shown to be 37.34% [25]. Prevalence of cardiovascular diseases might be

increased. This may happen with high prevalence of metabolic syndrome among postmenopausal women. Study of Deibert et al [42] showed that prevalence of metabolic syndrome among post-menopausal women was 36.1% and also some other studies showed that menopausal women in Canada [43], Ecuador [33] and South Korea [44] had prevalence of metabolic syndrome 31%, 41.5% and 54.6% respectively. Marjani et al showed that the prevalence of metabolic syndrome among postmenopausal women was 31% [45].

In a study showed that 33.7% of men and 46.8% of women had metabolic syndrome (by two definitions NCEP-ATPIII and IDF) [46]. In the United States, 39% and 34.5% of adults had metabolic syndrome by two definitions, respectively [47]. In an another study done in South Australia, the prevalence of the metabolic syndrome was higher by the IDF definition (22.8%) when compared with the ATP III definition (15%) [48]. The prevalence in Isfahan (Iran) was 65.0% with higher rate in females than males (71.7% female and 55.8% male) [36]. The prevalence in Karachi (Pakistan) was 79.7% in type 2 diabetics, (45.5% females and 34.3% males) [37]. The overall prevalence of metabolic syndrome in Japanese type 2 diabetic patients was 168 (26.37%) out of 637 type 2 diabetic patients. The prevalence was higher in males (45.9%) than females (28.0%) [38]. Study of Marjani et al showed that according to ATP III and IDF diagnostic criteria, in type 2 diabetic patients, the frequency of metabolic syndrome was 75.42% and 76.79%, respectively. Females were more affected according to two criteria [49].

Differences in the prevalence of metabolic syndrome can result from differences in genetic factors. Studies among Korean and Chinese populations showed that prevalence of metabolic syndrome were 13.8% [44] and 17.8% for females, respectively [50]. Studies were done by Eshtiagh [51], Ainy [52], Deibert [42], Figueiredo Neto [53] and Heidari et al [54] have shown that prevalence of metabolic syndrome were 18.3%, 53%, 23%, 24% and 44.9%, respectively. Studies in Greece and USA have shown that prevalence of metabolic syndrome was similar in both genders [9, 55]. Some other studies in Turkey, India, Iran, African Americans, Mexican Americans have shown that women to be much more frequently affected [3, 9], while in France and Australia the metabolic syndrome was found to be more common among men [3]. In Fars and Sistani ethnic group in Gorgan (Iran), the frequency of metabolic syndrome was 20.62% and 23.75%, respectively [56-57].

## Conclusion

It appears that the female type 2 diabetic patients need to change their life style to halt the burden of cardiovascular complications in type 2 diabetic patients. Clinicians should significantly consider screening all people regardless of age for abnormalities in glucose level. Early treatment in people

with abnormal glucose level constitutes a strategy of preventing type 2 diabetes mellitus and metabolic syndrome.

Postmenopausal status might be a predictor of metabolic syndrome. Some related factors of metabolic syndrome among postmenopausal women may increase cardiovascular risk in postmenopausal women. Studies about metabolic syndrome have shown that females were more affected than males. This may be due to the specific characteristics in the lifestyle changes between females and males diabetic patients.

## Authors' Contributions

Abdoljalal Marjani gave the idea and designed the study. He wrote the final paper.

## Competing Interest

The author has no conflicts of interest.

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