

## Clinical Study

# The Metabolic Syndrome among Postmenopausal Women in Gorgan

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*Introduction.* The present study aimed to assess the metabolic syndrome among postmenopausal women in Gorgan, Iran. *Materials and Methods.* The study was conducted on hundred postmenopausal women who were referred to the health centers in Gorgan. Metabolic syndrome was diagnosed using Adult Treatment Panel III (ATP III) guidelines. *Results.* The mean body mass index, waist circumference, hip, circumference waist-to-hip ratio, diastolic blood pressure, and triglyceride and fasting blood glucose levels were significantly high among postmenopausal women with metabolic syndrome, but the mean HDL-cholesterol was significantly low ( $P < 0.05$ ). Overall prevalence of metabolic syndrome was 31%. Body mass index and waist circumference had a positive correlation with a number of metabolic syndrome factors ( $P < 0.001$ ). Body mass index, waist circumference, and waist-to-hip ratio had a positive correlation with each other ( $P < 0.001$ ). BMI had relatively high correlation with WC ( $P < 0.001$ ). *Conclusions.* Our results show that postmenopausal status might be a predictor of metabolic syndrome. Low HDL-cholesterol level and high abdominal obesity are the most frequent characteristics in comparison to other metabolic components. Our study also showed some related factors of metabolic syndrome among postmenopausal women. These factors may increase cardiovascular risk among postmenopausal women with metabolic syndrome.

## 1. Introduction

The metabolic syndrome (MetS) is described by the clustering 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]. Some studies showed the prevalence of metabolic syndrome among postmenopausal women in China, India, and Brazil to be 33.5%, 55%, and 34.7%, respectively [3–5]. Differences in genetic background, diet, levels of physical activity, age and sex structure all influence the prevalence

of both metabolic syndrome and its components [6]. Cardiovascular disease is one of the main reasons of death among women in the world [7]. The studies indicated that women aged more than 55 have a higher incidence of cardiovascular disease than younger women [8–10]. Other studies showed that there is a high prevalence of metabolic syndrome among postmenopausal women, which varies from 32.6% to 41.5% [11–13]. Study of Rossi et al. [14] 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 [15]. Some studies have shown that there is no difference in cardiovascular risk factors when comparing premenopausal with postmenopausal women [15–18]. In several studies, the incidences of metabolic syndrome among postmenopausal women were found to be increased in the world [19, 20].

Some other studies showed that there is an elevation in systolic blood pressure [21], serum total cholesterol, and triglycerides [22] and a reduction in HDL-cholesterol levels [23] among postmenopausal women. Studies in Iran showed that prevalence of the metabolic syndrome was 35–58% [24, 25]. There is no data on the prevalence of metabolic syndrome among postmenopausal women in Gorgan (South East of Caspian Sea), Iran. Therefore, it is very important to set up a study on the postmenopausal women with a risk of metabolic syndrome. The present study aimed to assess the metabolic syndrome among postmenopausal women in this area.

## 2. Subjects and Methods

This cross-sectional study was performed in the Biochemistry and Metabolic Disorders Research Center of Gorgan, Golestan province (South East of Caspian Sea, North East of Iran) in 2011. The study was conducted on hundred postmenopausal women who were referred to the different health centers in Gorgan. Postmenopausal women who had at least 1-year history of cessation of menses were included. All the included subjects provided an informed consent. At the point of study entry, all study participants were subjected to clinical and biochemical investigations. Data were collected by trained interviewers. First of all, a questionnaire was completed at each health center by trained interviewers. Demographic information is achieved by a questionnaire. The exclusion criterion was the coexistence of any other serious illness; this included having hormone replacement therapy, taking drugs such as antidiabetes and antihypertensive antilipidemic, agents and smokers. A venous blood sample was collected from all the subjects who came after 8–12 hours in the morning after an overnight fast. The samples were centrifuged for 10 minutes at 3000 rpm. The serum was used for estimating fasting blood glucose, triglycerides, total cholesterol, LDL-cholesterol, and HDL-cholesterol concentrations, by biochemical kit using spectrophotometer techniques (Model JENWAY 6105 UV/VIS) in the Biochemistry and Metabolic Disorders Research Center (School of Medicine). Postmenopausal women were considered to have metabolic syndrome if they had any three or more of the following, according to the ATP III Criteria: [2]

- (A) abdominal obesity: waist Circumference >88 cm,
- (B) hypertriglyceridaemia: serum triglycerides level >150 mg/dL,
- (C) low HDL-cholesterol: <50 mg/dL,
- (D) high blood pressure: SBP > 130 mmHg and/or DBP > 85 mmHg or on treatment for hypertension,
- (E) high fasting glucose: serum glucose level > 110 mg/dL or on treatment for diabetes.

Weight was then measured, while subjects were minimally clothed without shoes, using digital scales. Height was measured in standing position without shoes using tape meter while the shoulder was in a normal position. Body

mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Those with a BMI of 25.0–29.9 Kg/m<sup>2</sup> were classified as overweight, whilst those with a BMI  $\geq$  30 Kg/m<sup>2</sup> were defined as obese. Subjects with BMI greater than 45 Kg/m<sup>2</sup> were considered very obese [26]. Waist circumference was measured at the point halfway between the lower border of ribs and the iliac crest in a horizontal plane [27], and hip circumference was measured at the widest level over the greater trochanters. Waist-to-hip ratio was calculated as waist circumference divided by hip circumference. Systolic and diastolic blood pressure was measured twice after 10–15 minutes resting in sitting position from the right hand. Two measurements were done all postmenopausal women at five-minute intervals and we used the average of the 2 measurements. The results were reported as percentages and mean  $\pm$  SD. The statistical analysis was done with SPSS-16 version software. The results were evaluated by using Student T-test and logistic regression analysis. Statistical significance was considered at  $P < 0.05$ .

## 3. Results

A total of hundred postmenopausal women were studied. Table 1 shows the baseline data of postmenopausal women with and without metabolic syndrome. The mean age of subjects was  $54.12 \pm 5.28$  years, and the mean number of years since menopause was  $5.22 \pm 3.40$ . The mean body mass index, waist circumference, hip, waist-to-hip ratio, diastolic blood pressure, and triglyceride and fasting blood glucose levels were significantly high among postmenopausal women with metabolic syndrome, but the mean HDL-cholesterol was low ( $P < 0.05$ ). There were no significant differences in the age, years since menopause, total cholesterol, systolic blood pressure, and LDL-cholesterol of postmenopausal women with and without metabolic syndrome. Table 2 shows the prevalence and component of metabolic syndrome among postmenopausal women with metabolic syndrome. Overall prevalence of the metabolic syndrome among postmenopausal women was 31%. The percentages of fasting blood sugar >110 mg/dL, high density lipoprotein-cholesterol < 50 mg/dL, Triglyceride > 150 mg/dL, waist circumference > 88 cm, and systolic blood pressure > 130 mmHg/diastolic blood pressure > 85 mmHg are presented in Table 2. The percentages of these components of metabolic syndrome among postmenopausal women were 17, 30, 16, 29, and 16%, respectively. Table 3 shows the correlation between the number of metabolic syndrome factors and body mass index, waist circumference, and waist-to-hip ratio. Linear regression analysis shows that body mass index and waist circumference had a positive correlation with the number of metabolic syndrome factors ( $P < 0.001$ ). BMI had relatively higher correlation with number of metabolic syndrome factors ( $P < 0.001$ ). Table 4 shows the correlation between body mass index, waist circumference, and waist-to-hip ratio. The pearson correlation analysis shows that all indices had a positive correlation with each other ( $P < 0.001$ ). BMI had relatively high correlation with WC ( $P < 0.001$ ).

TABLE 1: Baseline data of postmenopausal women (total subjects and subjects with and without metabolic syndrome).

| Parameters             | Total number of postmenopausal women | Postmenopausal women with metabolic syndrome | Postmenopausal women without metabolic syndrome | P value |
|------------------------|--------------------------------------|--|---|---------|
| All women, no. (%)     | 100                                  | 31   | 69  |         |
| Age (years)            | 54.32 ± 5.26                         | 54.51 ± 5.31                                 | 54.31 ± 5.39                                    | 0.865   |
| Years since menopause  | 5.36 ± 3.38                          | 5.0 ± 3.54                                   | 5.62 ± 3.37                                     | 0.403   |
| BMI, kg/m <sup>2</sup> | 30.98 ± 5.52                         | 33.68 ± 5.40                                 | 29.77 ± 5.17                                    | 0.001   |
| WC, cm                 | 91.12 ± 11.70                        | 97.98 ± 9.47                                 | 88.04 ± 11.34                                   | <0.001  |
| Hip circumference, cm  | 104.61 ± 9.23                        | 109.03 ± 10.43                               | 102.62 ± 7.95                                   | 0.001   |
| WHR                    | 0.87 ± 0.09                          | 0.89 ± 0.07                                  | 0.84 ± 0.13                                     | 0.030   |
| SBP, mmHg              | 150.23 ± 17.02                       | 160.0 ± 20.45                                | 135.32 ± 1.83                                   | 0.505   |
| DBP, mmHg              | 78.72 ± 1.24                         | 83.61 ± 1.10                                 | 76.52 ± 1.25                                    | 0.008   |
| FBS, mg/dL             | 107.66 ± 63.53                       | 143.45 ± 100.38                              | 91.57 ± 24.17                                   | 0.008   |
| TG, mg/dL              | 122.94 ± 91.67                       | 171.90 ± 124.20                              | 100.94 ± 62.0                                   | <0.001  |
| T-Chol, mg/dL          | 210.87 ± 49.28                       | 219.71 ± 49.80                               | 206.90 ± 48.88                                  | 0.231   |
| HDL-Chol, mg/dL        | 46.49 ± 14.23                        | 42.54 ± 8.60                                 | 48.26 ± 15.86                                   | 0.022   |
| LDL-Chol, mg/dL        | 129.32 ± 40.52                       | 128.32 ± 44.23                               | 129.77 ± 39.07                                  | 0.870   |

BMI: body mass index, WC: waist circumference, WHR: waist-to-hip ratio, SBP: systolic blood pressure, DBP: diastolic blood pressure, FBS: fasting blood glucose, TG: triglyceride, T-CHOL: total cholesterol, HDL-CHOL: HDL-cholesterol, and LDL-CHOL: LDL-cholesterol.

TABLE 2: Prevalence of metabolic syndrome and the components of metabolic syndrome in postmenopausal women.

|   | Number | %  |
|---|--------|----|
| Metabolic syndrome  | 31     | 31 |
| Fasting blood sugar > 110 mg/dL                                       | 17     | 17 |
| High-density lipoprotein-cholesterol < 50 mg/dL                       | 30     | 30 |
| Triglyceride > 150 mg/dL  | 16     | 16 |
| Waist circumference > 88 cm   | 29     | 29 |
| Systolic blood pressure > 130 mmHg/diastolic blood pressure > 85 mmHg | 16     | 16 |

TABLE 3: Regression analysis of number of the metabolic syndrome factors versus BMI, WC, and WHR.

|                | BMI   | WC    | WHR   |
|----------------|-------|-------|-------|
| R              | 0.511 | 0.406 | 0.213 |
| R <sup>2</sup> | 0.261 | 0.165 | 0.045 |
| Coefficient    | 0.053 | 0.024 | 1.667 |
| Constant       | 1.623 | 1.039 | 1.926 |
| P              | 0.003 | 0.024 | 0.251 |

BMI: body mass index, WC: waist circumference, and WHR: waist-to-hip ratio.

#### 4. Discussion

In our study, we found that the mean body mass index, waist circumference, hip circumference, waist-to-hip ratio, diastolic blood pressure, and triglyceride and fasting blood glucose levels were significantly high among postmenopausal

TABLE 4: Correlation between the anthropometric indices in postmenopausal women.

|     | BMI    | WC     | WHR    |
|-----|--------|--------|--------|
| BMI | —      | 0.807* | 0.363* |
| WC  | 0.807* | —      | 0.742* |
| WHR | 0.363* | 0.742* | —      |

\*P < 0.001.

women with metabolic syndrome, but the mean HDL-cholesterol was low. Many studies address the relation of menopause with blood pressure. The study of Bengtsson showed that there is a little reduction in systolic blood pressure after menopause [28]. Some other studies showed that blood pressure is not changed with menopausal status [29]. It has been shown that there is an elevation in systolic blood pressure among postmenopausal women without any change in diastolic blood pressure [30]. Our study shows that systolic and diastolic blood pressure was high among postmenopausal women with metabolic syndrome. Our study also shows that diastolic blood pressure was significantly high among postmenopausal women with metabolic syndrome. This may suggest that diastolic blood pressure is one of the risk factors for cardiovascular disease among postmenopausal women with metabolic syndrome. Our study shows that triglycerides were significantly high among postmenopausal women with metabolic syndrome. There are different studies about the menopausal effect on triglycerides. Some studies showed no effect [15, 31, 32] while other studies showed elevations of triglyceride levels after menopause [23, 33, 34]. Our finding shows

low HDL-cholesterol level among postmenopausal women with metabolic syndrome. There are some studies showing reduction and elevation of HDL-cholesterol levels following menopause [23, 35]. Most studies have shown that plasma HDL-C levels either fall slightly [36–38] or remain stable [16] with menopause. Some studies show increasing of plasma HDL-C levels after menopause in Korean and Iranian population [39, 40]. The study of Kreisberg showed that reductions in HDL-cholesterol should be taken into account as one of coronary heart disease risk factors among postmenopausal women [41]. It has been shown that there is an increase in fasting blood sugar among postmenopausal women with metabolic syndrome [42]. Our results showed a significant increase in fasting blood sugar between postmenopausal women with and without metabolic syndrome. Waist circumference was elevated among postmenopausal women with metabolic syndrome. It was also shown that postmenopausal women were overweight and obese. Body mass index and waist circumference have shown to have positive correlation with the number of metabolic syndrome factors, and also body mass index, waist circumference and waist-to-hip ratio had a positive correlation with each other. The study of Lobo showed that weight increase and obesity greatly increase prevalence of metabolic syndrome among postmenopausal women. Changes in central obesity can cause metabolism abnormality and influence health [43]. Estrogen secretion is decreased among postmenopausal women depending on metabolic alterations and resulting agglomeration of abdominal fat. It is important to reduce the risk of cardiovascular disease among postmenopausal women. It suggests that among postmenopausal women blood glucose, blood pressure, lipid profile monitoring and changing their life style can lead to weight loss by diet and sport [44]. The prevalence of metabolic syndrome among postmenopausal women is 31%. The study on postmenopausal women in Austria showed that the prevalence of metabolic syndrome was 32.6% [45] which was similar to that in our finding. In another study on postmenopausal women in Chengdu, China, the prevalence of metabolic syndrome was shown to be 37.34%, which was higher than our finding [12]. In our study, we found high prevalence of the components of metabolic syndrome among postmenopausal women. Low HDL-cholesterol and high waist circumference were the most usual factors of metabolic abnormality among postmenopausal women. Prevalence of cardiovascular diseases might be increased. This may happen with high prevalence of metabolic syndrome among postmenopausal women. The study of Deibert et al. [46] showed that prevalence of metabolic syndrome among postmenopausal women was 36.1% and also some other studies showed that menopausal women in Canada [47], Ecuador [20], and Republic of Korea [48] had prevalence of metabolic syndrome, 31%, 41.5%, and 54.6%, respectively.

In conclusion, our results show that postmenopausal status might be a predictor of metabolic syndrome in this area. In this study, low HDL-cholesterol level and high abdominal obesity are the most frequent characteristics in comparison to other metabolic components. Our study also showed some related factors of metabolic syndrome among

postmenopausal women. These factors may increase cardiovascular risk in postmenopausal women with metabolic syndrome.

### Authors' Contribution

A. Marjani gave the idea, designed the study and wrote the final paper. S. Moghasemi is co-author and was responsible for the management of the patients and collection of medical assessment findings.

### Conflict of Interests

The authors have no conflicts of interests.

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