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Original Article

# Relationship between metabolic syndrome and its components with bone densitometry in postmenopausal women

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ABSTRACT

*Background:* Prevention of osteoporosis and bone fracture and the relationship between metabolic syndrome and bone density are controversial issues.
*The aim of this study:* The aim of this study was to evaluate the association between metabolic syndrome and its components with bone mineral density in post menopausal women referred for bone mineral density (BMD) test.
*Methods:* A total of 143 postmenopausal women with at least one year of menopause experience participated in this cross-sectional study. Demographic and anthropometric characteristics for all participants were collected. Also, biochemical parameters including fasting blood sugar, Cholesterol (HDL and LDL), triglyceride were measured. Association between the components of metabolic syndrome and bone densitometry were analyzed by statistical methods.
*Results:* In this study, 72% of participants did not have metabolic syndrome. Among them, 43.4% and 28.7% had osteoporosis and normal density, respectively. Of remaining participants with metabolic syndrome, 12.6% and 15.4% had osteoporosis and normal density, respectively. Among the metabolic syndrome components, waist circumference, HDL cholesterol, and waist to hip ratio were significantly associated with bone mass ($P < 0.05$). Osteoporotic women had lower waist circumference and waist to hip ratio and higher HDL than women without osteoporosis. On the other hand, women with metabolic syndrome did not have significant differences than women without metabolic syndrome in terms of lumbar and femoral neck density ($P > 0.05$).
*Conclusion:* Results from this study showed that metabolic syndrome and its components did not induce bone mass loss. The discrepancies of the studies in this area call for more large scale studies in population so as to prevent women problems in this area.


## 1. Introduction

Metabolic syndrome refers to a set of conditions that occur together including high blood pressure, elevated insulin level in blood, increased body fat around the waist, high triglyceride, and low HDL cholesterol. Simultaneous existence of these conditions increases the risk of heart disease, stroke, and diabetic status [1,2]. The literature review shows that increasing CRP (a marker of systemic inflammation) is associated with osteoporosis and non-traumatic fractures [3]. Also, the metabolic syndrome is a disease that is associated with the presence of inflammation in the body [4]. Therefore, systemic inflammation associated with metabolic syndrome may activate bone resorption process that leads to reduced bone density [5]. On the other hand, other component of the metabolic syndrome (obesity or increased body mass index) is known as a protective factor against the development of osteoporosis [6]. Therefore, in patients with metabolic syndrome, simultaneous action of two factors with opposite effects on bone mineral density has been observed. These factors include obesity as a known protective factor against osteoporosis and inflammatory processes that activate bone resorption [1,5]. Previous studies have investigated the association between these factors and osteoporosis, but the results of these studies are inconsistent [7]. For example, the results regarding the relationship between high triglyceride and low levels of HDL cholesterol with bone mineral density (BMD) is incompatible. Moreover, there are conflicting reports about the relationship between high blood pressure and

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BMD [8,9]. While it seems that being overweight and obese protects the individual against bone loss while aging, studies have shown that abdominal obesity is associated with osteopenia and osteoporosis [10]. Some studies have mentioned hyperglycemia as a predictor of low bone mass or osteoporosis, but have not reached a definitive conclusion about its relationship with BMD [10,11]. Although the inflammation caused by metabolic syndrome can lead to a decrease in bone density, recent studies have reported that metabolic syndrome reduces the risk of non-costal bone fractures [8,12].

Due to the above mentioned reasons and the importance of prevention of osteoporosis and bone fractures, the relationship between metabolic syndrome and bone density is still a controversial issue. The aim of this study was to evaluate the association between metabolic syndrome and its components with bone density in women referred for bone mineral density (BMD) test.

## 2. Methods

This cross-sectional study was done in rheumatology department of a university hospital in Qazvin. One hundred forty three women aged between 39 to 87 years were enrolled from patients referred for bone densitometry. In this study, sampling was done through non-probability sampling method. This study was conducted in accordance with the research priorities of Qazvin University of Medical Sciences and was approved by the ethics committee of the university. Informed consent was taken from all patients. Inclusion criteria included all women who were referred for bone densitometry. Exclusion criteria were a history of rheumatic diseases such as rheumatoid arthritis in patients and use of corticosteroids. Structured medical interviews and medical examinations by rheumatologist were done for all patients. Women with diagnosis of osteoporosis in BMD test were considered as patients while those with normal result of BMD were considered as healthy women. The Bone Mineral Density was measured using dual-energy X-ray absorptiometry at lumbar spine and femoral neck (Hologic QDR 2000, Bedford, MA, USA model) [13]. Results of BMD were categorized according to the WHO criteria. According the WHO criteria, women with spine or femur neck T-score equal or below −2.5 were considered as having osteoporosis. T-score between −1 to −2.5 and more than −1 were considered as having osteopenia and normal people, respectively.

Other patients' information including age (year), height (meter), weight (kilogram), and years from menopause were recorded. Body mass index (BMI) was calculated by dividing weight (in kilograms) by the square of weight. Waist and hip circumferences were measured at the level of the umbilicus and the symphysis of pubis, respectively. Also, the ratio between these two indices was calculated. Blood biochemical tests including fasting blood sugar, high density lipoprotein cholesterol, and low density lipoprotein cholesterol were done for all the participants. Women with and without a diagnosis of metabolic syndrome were considered as positive and negative exposure, respectively.

The diagnosis of metabolic syndrome was done using the criteria proposed by the Third Report of the National Cholesterol Education Program [14]. According to the criteria, diagnosis of metabolic syndrome requires three or more of the followings: waist circumference ≥88 cm; high blood pressure (systolic blood pressure ≥130 mmhg and diastolic blood pressure ≥85 mmhg); HDL cholesterol ≤50 mg/dl; and fasting blood sugar ≥100 mg/dl. Distribution of all anthropometric and laboratory data were evaluated. Data were presented using frequency and percentage for categorical variables. Chi-square test was used to compare qualitative variables, and independent *t*-test was used for compare continuous variables. All statistical analyses were performed using SPSS software version 19 and p-value less than 0.05 was considered statistically significant.

## 3. Results

A total of 143 women participated in this study. Among them, 80 (55.9%) patients suffered from osteoporosis, and 40 (28%) patients had metabolic syndrome. Table 1 compares results from anthropometric data and biochemical blood tests between patients with normal bone density and osteoporosis. As seen in Table 1, variables including age, waist circumference and waist-hip ratio was significantly different in those with normal bone density than osteoporotic patients (P-value < 0.05).

The mean age of the patients with normal bone density was 33/7 ± 47/53, compared to 21/8 ± 03/60 in osteoporotic patients. This difference was statistically significant (P = 0.001). Also, mean waist circumference in normal bone density and osteoporotic group was 101.6 ± 9.1 and 95.9 ± 11.9, respectively. Its difference was statistically significant (P = 0.002) as well. In relation to blood biochemical parameters, only HDL cholesterol was significantly higher in osteoporotic women than those with normal density (P = 0.031).

Analysis of variables in this study was also performed using criteria proposed by NCEP (ATPIII). As seen in Table 2, twenty two women had a waist circumference less than 88 centimeters, among which, 19 (13.3%) patients suffered from osteoporosis and 3 (2.1%) patients had normal bone density. On the other hand, one hundred twenty one women had a waist circumference higher than 88 centimeters, among which, 61 (42.7%) patients suffered from osteoporosis and 60 (42%) patients had normal bone density. This difference were analyzed using chi-square test and was meaningful (P = 0.002). Another significant variable in the results was HDL cholesterol. Twenty four women of the total participants had HDL cholesterol level of ≤50, among which, 13 (9.09%) and 11 (7.69%) were osteoporotic and normal women, respectively (P = 0.031). Results for other biochemical parameters (fasting blood sugar and triglyceride) and blood pressure are shown in Table 2. Overall, as it

**Table 1**
comparison results from anthropometric data and biochemical blood tests between patients with normal bone density and osteoporosis.

| | Normal bone density (n = 63) | Osteoporosis (n = 80) | P-value |
|---|---|---|---|
| Waist circumference (cm) | 101.58 ± 9.15 | 95.92 ± 11.97 | 0.002* |
| Waist to hip ratio | 0.92 ± 0.9 | 0.88 ± 0.86 | 0.002* |
| Systolic blood pressure (mmhg) | 121.74 ± 19.55 | 119.45 ± 18.29 | 0.471 |
| Diastolic blood pressure (mmhg) | 74.12 ± 13.29 | 70.5 ± 14.31 | 0.124 |
| Fasting blood sugar (mg/dl) | 112.11 ± 49.55 | 102.91 ± 30.71 | 0.175 |
| HDL (mg/dl) | 50.33 ± 11.76 | 55.03 ± 13.55 | 0.031* |
| LDL (mg/dl) | 113.41 ± 32.76 | 116.3 ± 35.28 | 0.617 |
| TG (mg/dl) | 153.5 ± 72.02 | 133.8 ± 65.96 | 0.091 |
| Age (years) | 53.47 ± 7.33 | 60.03 ± 8.21 | 0.001* |
| BMI (kg/m2) | 31.61 ± 7.95 | 33.64 ± 9.22 | 0.75 |

* p < .05 instudent *t*-test used for comparison between groups.

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