



## Original article

# Vitamin D status and its relationship with bone mineral density in a healthy Iranian population



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## ABSTRACT

**Objectives:** Considering the controversial results regarding the relationship between vitamin D levels and bone mineral density in different populations, the present study was designed to evaluate this correlation in a healthy Iranian population.

**Methods:** Using a random cluster sample of apparently healthy men and women, this multi-center cross-sectional study was carried out among 4450 individuals living in urban areas of five major cities in Iran. Bone mineral density (BMD) values at different sites were analyzed along with the serum levels of 25(OH)D and PTH. Analysis of variance (ANOVA) was used to estimate the main effects, through comparing the mean values of these markers based on the bone mineral density status of the study group in each sex.

**Results:** 25(OH)D levels were inversely correlated with BMD values at total hip ( $r = -0.062$  in men and  $r = -0.057$  in women) and spine ( $r = -0.076$  in men and  $r = -0.107$  in women). After adjusting the data for age, the inverse correlation was no longer statistically significant.

**Conclusion:** Serum 25(OH)D levels are inversely correlated with bone mass values in both sexes.

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## Correlação entre os níveis de vitamina D e densidade mineral óssea em uma população iraniana saudável

## RESUMO

**Objetivos:** Considerando os resultados controversos sobre a relação entre níveis de vitamina D e densidade mineral óssea em diferentes populações, o presente estudo foi desenhado para avaliar esta correlação em uma população iraniana saudável.

## Palavras chave:

Densidade mineral óssea

Osteoporose

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Biomarcadores  
Vitamina D  
Fósforo  
Cálcio

**Métodos:** Usando uma amostra aleatória de homens e mulheres aparentemente saudáveis, este estudo transversal multicêntrico considerou 4450 indivíduos que vivem em na região urbana de cinco grandes cidades no Irã. Os valores da densidade mineral óssea (DMO) foram analisados em conjunto com os níveis séricos de 25(OH)D e PTH. Análise da variação (ANOVA) foi utilizada para estimar os principais efeitos através da comparação entre os valores médios destes marcadores e a condição da densidade mineral óssea de cada gênero nesta amostra de estudo.

**Resultados:** Níveis de 25(OH)D foram inversamente proporcionais aos valores de DMO a nível do quadril ( $r = -0.062$  em homens e  $r = -0.057$  em mulheres) e coluna vertebral ( $r = -0.076$  em homens e  $r = -0.107$  em mulheres). Após ajuste dos dados para idade, a correlação negativa não foi mais estatisticamente significativa.

**Conclusão:** Níveis séricos de 25(OH)D são inversamente correlacionados com os valores de massa óssea em ambos os gêneros.

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## Introduction

Osteoporosis is a systemic disease characterized by low bone mass and microarchitectural deterioration of bone tissue, resulting in an increased risk of fracture; if identified early in its course, however, many of the fractures can be prevented.<sup>1</sup>

Apart from modifiable lifestyle factors, bone mineral density (BMD) is influenced by several genetic, environmental, and hormonal factors.<sup>2,3</sup> While the influence of biochemical markers on the fracture risk has been well documented in previous studies, the association between serum 25(OH)D levels and BMD in different ethnicities residing in different geographic areas remains controversial. Many of them have reported no direct relationship between serum 25(OH)D levels and BMD was observed.<sup>4</sup>

The present study therefore was designed to evaluate the relationship between vitamin D status, bone mineral density and PTH in a healthy Iranian population.

## Materials and methods

### Subject selection

This study is part of a comprehensive survey (IMOS) assessing the prevalence of osteoporosis and related factors among healthy adults (age range: 20–70 Years), representative sample of Iranian population living in urban areas, in the urban areas of five major cities of Iran (Tehran, Tabriz, Mashhad, Shiraz and Booshehr) in late winter 2001 (February–March).

Details on the survey design and methods have been reported previously.<sup>5</sup> Briefly, the IMOS used a random cluster sampling design to draw five provincially representative, independent samples of healthy adults excluding those taking medications that could modify bone metabolism, those with hepatic or renal disorders, metabolic bone disease, hypercortisolism, malabsorption, sterility, oligomenorrhea, diabetes, malignancy, and immobility for more than 1 week as well as the pregnant and lactating women. The Research Ethics Committee of the Endocrine and Metabolism Research Center (EMRC) approved the protocol of this study. An informed

consent was obtained from the subjects before they entered the study.

All subjects underwent a detailed medical examination, measurement of bone mineral density at different sites, and certain biochemical testing. Apart from demographic data, the subjects were asked about their menopausal status and the years passed since their menopause. Menopause, in this study, was defined as previous natural or surgical cessation of menstruation for more than 12 months.

### Biochemical tests

A fasting blood sample (10 cm<sup>3</sup> of venous blood) was taken from all participants at their residence place. Sample centrifuge and serum extraction were done in the field. The samples were then frozen and sent to the EMRC laboratory for further analysis.

Serum Ca and P levels were analyzed by a calorimetric method using Chem. Enzyme Lab Kit; Iran. The normal laboratory range for serum Ca was 8.6–10.8 mg/dl and for serum P was 2.3 to 5 mg/dl. Serum levels of vitamin D (25 (OH) D) and PTH were measured with RIA (Radio-Immuno-Assay) method (IDS Ltd Kit; UK) and IRMA (Immuno-Radiometric) method (Diasorin Kit; USA), respectively. Normal range for serum 25(OH)D and PTH were 23–113 ng/ml and 13–54 pg/ml, correspondingly. The inter- and intra-assay variations for the markers were 8%/6.8% and 8.9%/6.1%, respectively.

Based on 25(OH)D values, subjects were classified as those suffering from vitamin D deficiency ( $\leq 20$  ng/ml), – insufficiency (mild deficiency) (20–30 ng/ml) and – sufficiency (higher than 30 ng/ml). The complete method used to determine the 25(OH)D levels for classifying the participants is described in our previous studies.<sup>6,7</sup>

### Bone mineral density

In each city, patients underwent an L1–L4 anteroposterior lumbar spine, hip and its sub-regions DXA study with a Lunar DPXMD densitometer (Lunar 7164, GE, Madison, WI) equipped with NHANES III dataset by a trained operator according to the manufacturer's instruction. Results were expressed as T- and

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