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# DETERMINING THE RELATIVE FREQUENCY OF BONE MINERAL DENSITOMETRY (BMD) DISCORDANCE AND ITS RELATED FACTORS IN THE SPINE-FEMUR REGIONS USING THE DEXA METHOD

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## ABSTRACT

Osteoporosis is the most prevalent bone metabolic disease, which is diagnosed by the DEXA method. T-score discordance is noted by measuring DEXA in two different regions of the spine and the pelvis. Discordance occurs when the result of bone mineral densitometry between two regions falls under two different diagnostic classes, defined by the World Health Organization's classification system. Discordance is defined when two measured regions fall under a diagnostic class. Minor discordance denotes the difference between two regions in a diagnostic class, while major discordance refers to an osteoporosis region and a normal region. The present study aimed to determine the prevalence of discordance and related factors among patients with osteoporosis. This descriptive-analytical study was cross-sectional and involved 383 patients (339 women and 44 men) with an average age of 57.07±12.57. Data required were collected following the conduct of interviews, clinical examinations, and the analysis of bone mineral densitometry. Data were analyzed by SPSS software (version 13). Based on results, 53.8% of the subjects showed T-score discordance, while 49.89 and 3.91% were subjected to minor and major discordance, respectively. Higher ages were also found to affect discordance, while smoking served as a protective factor. Study showed that age had significant positive correlation with major discordance. In our study, an increase in age increased T-score discordance, whereas smoking increased the T-score concordance of two

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regions measured in osteopenia and osteoporosis classes because of causing bone resorption (osteoporosis) in both types of cortical and trabecular bones; meanwhile, the creation of discordance held a protective effect. Other causes had no effect in creating T-score discordance.

**KEYWORDS:** T-score discordance DEXA; Osteoporosis.

# DETERMINACIÓN DE LA FRECUENCIA RELATIVA DE LA DISCORDANCIA EN LA DENSITOMETRÍA MINERAL ÓSEA (DMO) Y SUS FACTORES RELACIONADOS EN LAS REGIONES DE LA COLUMNA VERTEBRAL Y EL FÉMUR UTILIZANDO EL MÉTODO DEXA

## RESUMEN

La osteoporosis es la enfermedad más prevalente Enfermedad metabólica ósea, que se diagnostica mediante el método DEXA. La discordancia del puntaje T se observa midiendo DEXA en dos regiones diferentes de la columna y la pelvis. La discordancia ocurre cuando el resultado de la densitometría mineral ósea entre dos regiones cae dentro de dos clases diagnósticas diferentes, definidas por el sistema de clasificación de la Organización Mundial de la Salud. La discordancia se define cuando dos regiones medidas caen dentro de una clase diagnóstica. La discordancia menor denota la diferencia entre dos regiones en

Volumen 15, N° 31. Julio-Diciembre 2025
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una clase diagnóstica, mientras que la discordancia mayor se refiere a una región de osteoporosis y una región normal. El presente estudio tuvo como objetivo determinar la prevalencia de discordancia y factores relacionados entre pacientes con osteoporosis. Este estudio descriptivo-analítico fue transversal e involucró a 383 pacientes (339 mujeres y 44 hombres) con una edad promedio de 57,07 ± 12,57. Los datos requeridos se recopilaron después de la realización de entrevistas, exámenes clínicos y el análisis de la densitometría mineral ósea. Los datos se analizaron con el software SPSS (versión 13). Según los resultados, el 53,8% de los sujetos mostraron discordancia en la puntuación T, mientras que el 49,89% y el 3,91% estuvieron sujetos a discordancia menor y mayor, respectivamente. También se encontró que las edades más altas afectaban la discordancia, mientras que el tabaquismo sirvió como factor protector. El estudio mostró que la edad tenía una correlación positiva significativa con la discordancia mayor. En nuestro estudio, un aumento en la edad aumentó la discordancia en la puntuación T, mientras que el tabaquismo aumentó la concordancia en la puntuación T de dos regiones medidas en las clases de osteopenia y osteoporosis debido a que causa resorción ósea (osteoporosis) en ambos tipos de huesos corticales y trabeculares; mientras tanto, la creación de discordancia tuvo un efecto protector. Otras causas no tuvieron efecto en la creación de discordancia en la puntuación T.

**PALABRAS CLAVE:** Discordancia en la puntuación T DEXA; Osteoporosis.

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## INTRODUCTION

Osteoporosis is the most common bone metabolic disease, which is associated with reduced bone mass and increased brittleness and fragility [1]. Osteoporosis risk factors include higher ages, female sex, low weight, primary hyperparathyroidism, hypogonadism, premature menopause, excessive alcohol consumption, smoking, excessive coffee consumption, some drug and family history . [2]. currently, bone mineral densitometry (BMD) measurement by DEXA is used as a golden standard to diagnose this disease, and the decision to start its treatment is made based on the results. According to the International Society for Clinical Densitometry (ISCD), it is essential to at least measure two regions to make decisions, as a diagnosis is made based on the lowest T-score [3, 4]. Consistent with WHO criteria, if T-score is -2.5 or lower, osteoporosis is diagnosed, while if it ranges from -1 to -2.5, it is osteopenia. However, if T-score is -1 or higher, the individual is said to be healthy [5]. T-score discordance between L1 to L4 regions of the spine and the pelvis is a common phenomenon in bone mineral densitometry [6-9]. T-score discordance refers to the discrepancy of the T-score of an individual between a standard region of the bone mineral densitometry and another region [10-12]. T-score discordance is divided into two groups (minor and major). Minor discordance occurs when the T-score discrepancy between two regions is not more than a diagnostic WHO class; for example, a

Volumen 15, N° 31. Julio-Diciembre 2025
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region is osteoporotic, while another region is osteopenia, or a region is osteopenia, and another region is normal. Major discordance occurs when a region is normal and another region is osteoporotic [13-15]. Discordance is noted in the diagnostic and treatment process of osteoporosis. Thus, it is required to identify and examine this phenomenon and its causes.

## Materials and Methods

This is a cross-sectional study that collected data from June 2021 to June 2022. As suggested by the International Osteoporosis Foundation indicators, the patients who had performed bone mineral densitometry, and presented to Yazd's densitometry center were selected. The patients with defective data and unsatisfied participation were excluded from the study. First, using the interview method, such data as age, smoking, menopause in women, the history of taking glucocorticoid medications such as prednisolone with the dosage of 5 mg or its equivalence for over 3 months, rheumatoid arthritis, the family history of osteoporosis in first-degree relatives, and fracture in adulthood were extracted and recorded in the questionnaire. Patients with scoliosis, osteoarthritis, and hip dislocation were identified by history and clinical examination and entered the study. The height and weight of the patients were measured by a stadiometer and a smart weighing scale; then, they were recorded in the questionnaire. Bone mineral densitometry stages in all patients

Volumen 15, N° 31. Julio-Diciembre 2025
Depósito Legal: PPI201102ME3815
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were performed by an operator. The patients were trained by a technician for the scanning procedure, and obstacles causing artificial discordance, including having a metal coin or a metal zipper, were removed. After performing the BMD analysis, the data were recorded in the questionnaire. The data collected was divided into various categories for statistical analyses. The subjects were in an age group of 20-59 and 60–89 years. Here, according to WHO criteria, the Body Mass Index (BMI) was divided into three normal ($18.5 \leq BMI < 25$), overweight ($25 \leq BMI < 30$), and obese ($BMI \geq 30$) categories, and concordance and discordance situations were classified based on WHO criteria. The study data were analyzed by SPSS software (version 13). This study had a significance level of 5%, while Chi-Square and Fisher's Exact Tests were used to analyze data.

## Results

As many as 383 patients entered the study. 44 of them were men and 339 (88.5%) were women. The average age of the patients at the time of data recording was 57.07±12.57 varying from 20–89 years. Out of the women, 254 (74.92%) were post-menopausal, and the average menopausal age was 48.25±6.38 years varying from 23–65 years. The average body mass index (BMI) in the studied samples was 27.82±4.72 varying from 14.86 to 42.86. Twenty-two people (5.7%) had a history of smoking. 232 people (60.6%) had a history of taking glucocorticoid medications. 173 people

(45.2%) suffered from arthritis. 186 people (48.6%) had rheumatoid arthritis. 129 people (33.7%) had a family history of osteoporosis. 52 people (13.6%) had scoliosis. 185 women (48.30%) and 21 men (5.48%) had T-score discordance. Out of the post-menopausal women, 144 (56.7%) had T-score discordance, 134 of whom (52.75%) had minor discordance and 10 (3.93%) had major discordance. 112 people (29.2%) had a history of fracture. 10 people (2.6%) had hip dislocation. 206 people (53.8%) had T-score discordance. Meanwhile, 49.89% had minor discordance, and 3.91% had major discordance. As age increased, the level of discordance increased. Also, bone resorption and its placement in osteopenia and osteoporotic classes increased with increased age (P-value=0.000) (Table 1).

**Table 1: Frequency distribution of the concordance and discordance classes of the spine-femur bone density by age**

| Age | Frequency/percentage | Concordance | | | Discordance | Total |
|---|---|---|---|---|---|---|
| | | Normal class | Osteopenia class | Osteoporosis class | | |
| 20-59 | Frequency | 55 | 40 | 14 | 103 | 212 |
| | Percentage | 2.95 | 1.98 | 6.6 | 48.6 | 100 |
| 60-89 | Frequency | 6 | 29 | 33 | 103 | 171 |
| | Percentage | 3.5 | 17 | 19.3 | 60.2 | 100 |
| Total | Frequency | 61 | 69 | 47 | 206 | 383 |
| | Percentage | 1.95 | 18 | 12.3 | 53.8 | 100 |
| P-Value ≃ 0.000 | | | | | | |

Smoking causes the resorption of both bone regions and places 50% of the smoking community in the concordance osteopenia and osteoporotic classes while preventing discordance (Fisher's Exact=0.04) (Table 2).

**Table 2: Relative frequency of the spine-femur bone density discordance by smoking**

| History of smoking | Frequency/percentage | Concordance | | | Discordance | Total |
|---|---|---|---|---|---|---|
| | | Normal class | Osteopenic class | Osteoporotic class | | |
| Yes | Frequency | 5 | 6 | 5 | 6 | 22 |
| | Percentage | 22.7 | 27.3 | 22.7 | 27.3 | 100 |
| No | Frequency | 56 | 63 | 42 | 200 | 361 |
| | Percentage | 15.5 | 17.5 | 11.6 | 55.4 | 100 |
| Total | Frequency | 61 | 69 | 47 | 206 | 383 |
| | Percentage | 15.9 | 18 | 12.3 | 53.8 | 100 |
| Fisher's Exact = 0.04 | | | | | | |

In men and non-postmenopausal women, the BMI is normal, and the people with scoliosis had greater concordance, while the level of discordance due to other reasons was greater; however, these relationships were not statistically significant (Figure 1).

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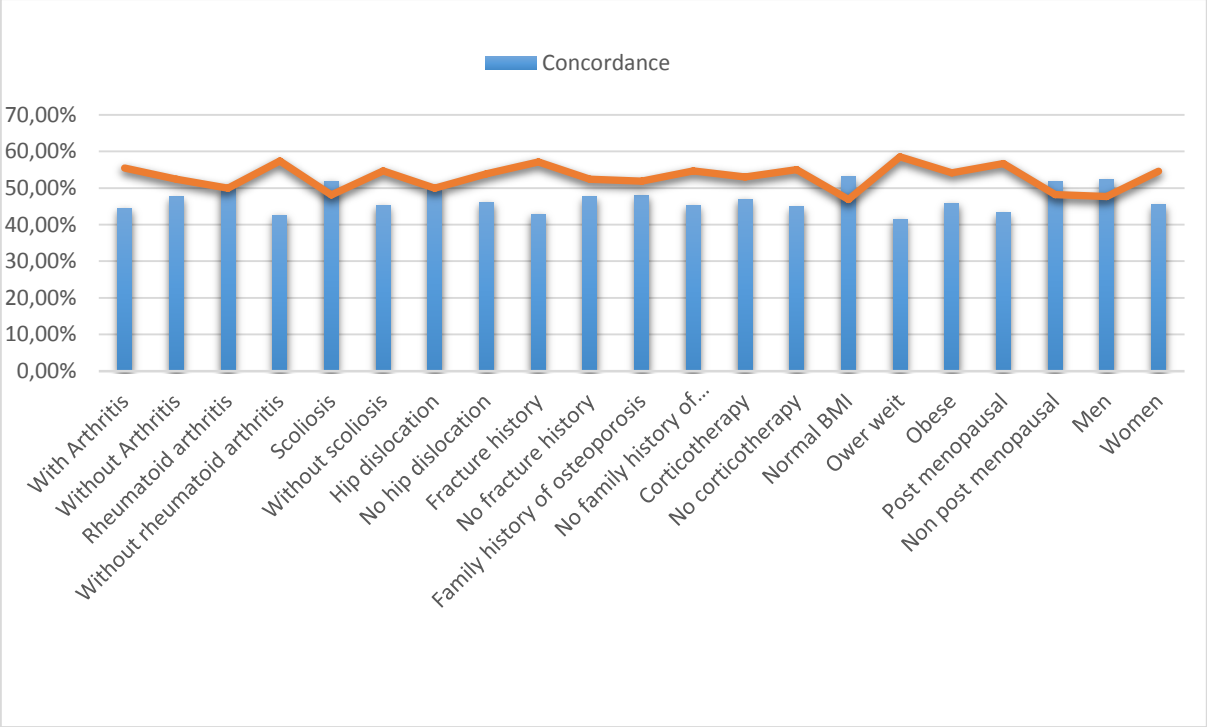


**Figure 1:** Concordance and discordance of other reasons affecting the bone density discordance

## Discussion

This study demonstrated that using WHO criteria for defining osteoporosis and osteopenia revealed that a large group of patients (53.8%) had T-score discordance between the spine and the hip. Minor discordance usually does not affect the patients' general prognosis. One of the reasons why osteoporosis is diagnosed with BMD in several regions is the phenomenon of discordance. The causes of discordance are physiological, pathological, anatomical, artificial, and technical [16]. In both minor and major

Volumen 15, N° 31. Julio-Diciembre 2025
Depósito Legal: PPI201102ME3815
ISSN: 2244-8136

discordances, lower lumbar spine BMD was more common, which could be due to some reasons, as the difference in the rate of bone loss in different parts of the human body may be the principal reason [17-19]. Trabecular bones (usually lumbar region), compared to cortical bones (usually proximal femoral bones) could be subjected to bone resorption faster [20]. In addition, the majority of secondary osteoporosis causes (e.g., such as glucocorticoids, hyperthyroidism, malabsorption, liver disease, rheumatoid arthritis, and medications) first affect the spinal column [21]. This could also lead to the prevalence of lumbar osteoporosis. Weight has positive correlation with major discordance [22]. With the increase in age, bone density reduced, which indicated increased bone resorption with the rising age. Discordance in people aged 60-89 was higher than that of the younger population. As for the effect of this parameter on causing bone density discordance between the spinal column and the femur, findings are conflicting, with some studies [23-27] confirming the effects of age on causing the discordance, and some others [28] dismissing it. The reason for this was due to the greater prevalence of osteoarthritis with the increased age, where the increased osteophytes caused the false density to increase in a region, and thus discordance. This study observed bone density discordance between the

Volumen 15, N° 31. Julio-Diciembre 2025
Depósito Legal: PPI201102ME3815
ISSN: 2244-8136

spinal column and the femur among smokers and non-users at 27.3% and 55.4%, being statistically significant. 22.73% of the smokers had minor discordance, and 60% of them had their femoral neck T-score one class lower than the total spinal column. 27.3% of the smokers had osteopenia class concordance, and 22.7% had an osteoporotic class concordance. In sum, the reason why discordance in smokers was lower than in non-smokers was that smoking would affect the femoral neck bone and the lumbar spine, and cause the resorption of both regions, as 50% of the smokers fell under osteoporotic and osteopenia concordance classes, causing the bone resorption of both regions, while 29.1% of the non-smokers had concordance in osteopenia and osteoporotic classes, with 54.40% of whom experiencing discordance. In some studies [26,28], no relation was found between smoking and discordance. Other causes examined in this study statistically explained the emergence or non-emergence of discordance. Like any other cross-sectional study, this study suffered from some limitations. Since the study was performed at a center affiliated with a training hospital, the assumption of the similarity of the population under study with an exact population was not rational and findings could not be generalized. This study also failed to investigate some of the factors causing or aggravating osteoporosis

Volumen 15, N° 31. Julio-Diciembre 2025
Depósito Legal: PPI201102ME3815
ISSN: 2244-8136

(e.g., hyperparathyroidism, anorexia, malabsorption, hyperthyroidism, etc.), which can also affect the findings. As for scoliosis, hip dislocation, and arthritis diseases, the small number of the studied population could not yield a clinical judgment about discordance. Future studies are suggested to use statistically powerful analytical tools and larger sample volumes to account for these limitations.

**Conclusion**

According to our study, the increased age was significantly related to discordant BMD in the hip and spine regions, with the rising age increasing discordance, as the parameter of smoking, while being a factor of osteoporosis and causing bone resorption in both types of cortical and trabecular bones, increased the level of concordance in the two measured regions in both osteoporotic and osteopenia classes. Conversely, the increased discordance phenomenon had a protective effect, and no statistical relation was found with other causes.

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