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

Hossein Soleymani Saleh Abadi[1], Maryam Tavakoli[2], Peyman Alipour[3], Sarina Alipour[4]

1. Assistant Professor of Rheumatology, Department of Internal Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

2. Medical Internist, Department of Internal Medicine, Aliebne-Abitaleb School of Medicaine, Islamic Azad University, Yazd Branch, Iran

3. Medical Student, Aliebne-Abitaleb School of Medicine, Islamic Azad University, Yazd Branch, Iran

4. Medical Student, School of Medicine, Hormozgan University of Medical Sciences, Bandra Abbas, Iran

EMAIL: hosseinsoleymanisalehabadi@gmail.com

CORRESPONDENCE: Dr. Hossein Soleymani Saleh Abadi

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

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

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 $57,07 \pm 12,57$. 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.

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

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

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 $\sim$ 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).
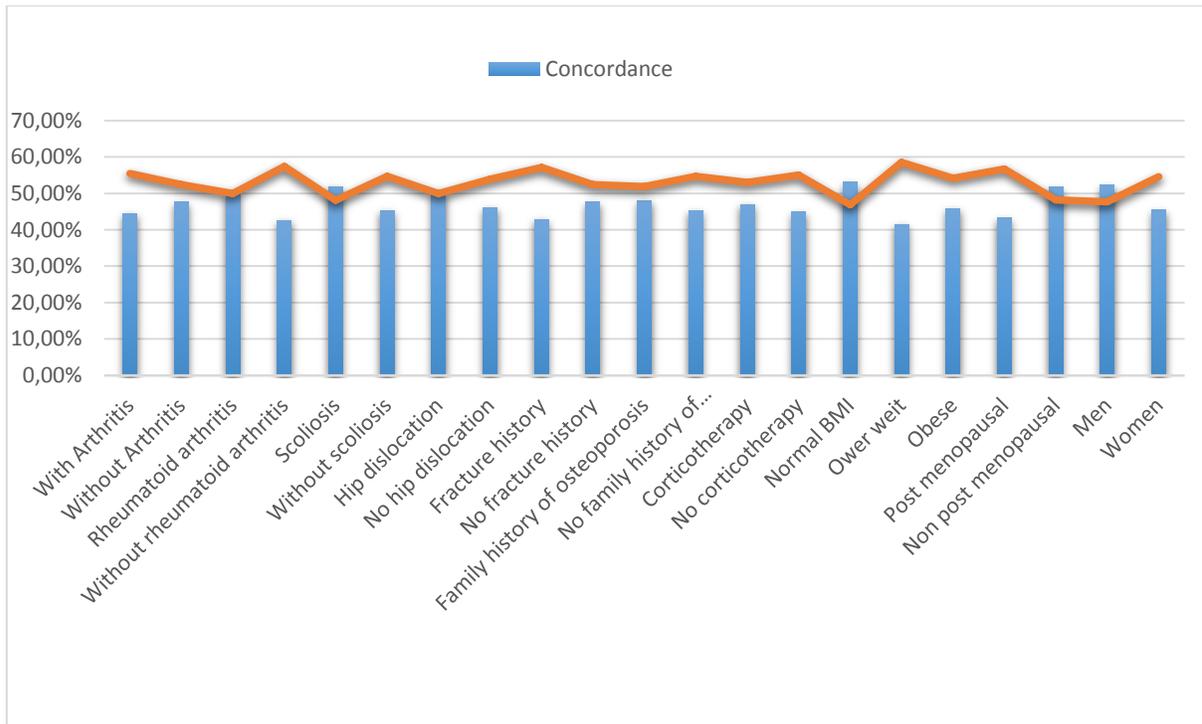
Figure 1: Concordance and discordance of other reasons affecting the bone density discordance

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

218

ACTA BIOCLINICA

Artículo Original

Hossein Soleymani y Col.

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

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

(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.

REFERENCIAS

1. Anthony S. Fauci EB, Dennis Kasper, Stephen L. Hauser, J. Larry Jameson, Tinsley R. Harrison. Harrison's Principles of Internal Medicine2019: 257-266.

2. Bagheri P, Haghdoost A, DORTAJ RE, Halimi L, Vafaei Z, Farhangnia M, et al. Ultra analysis of prevalence of osteoporosis in iranian women. 2011: 324-333.

3. Aghamohamadzade N NF, Bahrami A, Niafar M, Bgler L, Hajieghrari H,

Asgarzade A, Mobseri M. Low bone mass causes in osteoporotic and osteopenia patients. Gorgan university journal 2003;11:61-7.

4. Keramat A, Patwardhan B, Larijani B, Chopra A, Mithal A, Chakravarty D, et al. The assessment of osteoporosis risk factors in Iranian women compared with Indian women. BMC musculoskeletal disorders. 2008;9(1):28.

5. Varacallo MA, Fox EJ. Osteoporosis and its complications. Medical Clinics. 2014;98(4):817-31.

6. Davies L, Berridge D, Lyons J, Walters A, Lyons RA. 493 Cohort study of osteoporosis and fracture risk: are we achieving benefit with secondary prevention? : BMJ Publishing Group Ltd; 2016: 117-135.

7. Fleurence RL. Cost-effectiveness of fracture prevention treatments in the elderly. International journal of technology assessment in health care. 2004;20(2):184-91.

8. Kanis JA. Diagnosis and clinical aspects of osteoporosis. Pocket Reference to Osteoporosis: Springer; 2019: 11-20.

9. Abolhasani F SA, Mohamadi M. . Osteoporosis burden in Iran. Journal of Reproduction and Infertility 2001:25-36.

10. Lane NE. Epidemiology, etiology, and diagnosis of osteoporosis. American journal of obstetrics and gynecology. 2006;194(2):3-11.

11. Moazami Goodarzi H, Larijani B, Keshtkar A, Khashayar P. Prevalance and association factors of T-Scorediscordance between lumbar spine and femoral neck in postmenopausal women: A 11-year irosteops study Iranian Journal of

Diabetes and Metabolism. 2014;13(2):182-7.

12. Bover J, Bailone L, López-Báez V, Benito S, Ciceri P, Galassi A, et al. Osteoporosis, bone mineral density and CKD–MBD: treatment considerations. Journal of nephrology. 2017;30(5):677-87.

13. Silva DMW. Diagnosis of osteoporosis bone mineral density, risk factors, or both. EC Orthopaedics. 2018;9(7):500-2.

14. Moayyeri A, Soltani A, Tabari NK, Sadatsafavi M, Hossein-neghad A, Larijani B. Discordance in diagnosis of osteoporosis using spine and hip bone densitometry. BMC endocrine disorders. 2005;5(1):3.

15. Xu X-m, Li N, Li K, Li X-Y, Zhang P, Xuan Y-j, et al. Discordance in diagnosis of osteoporosis by quantitative computed tomography

and dual-energy X-ray absorptiometry in Chinese elderly men. Journal of Orthopaedic Translation. 2019;18:59-64.

16. Alarkawi, D., Bliuc, D., Nguyen, T. V., Eisman, J. A., & Center, J. R. Contribution of Lumbar Spine BMD to Fracture Risk in Individuals With T-Score Discordance. Journal of Bone and Mineral Research,2016; 31(2), 274-280.

17. Blumsohn, A., & Eastell, R. (1995). Age-related factors. Osteoporosis Etiology, diagnosis, and management, 161-182.

18. Yoon, B. H., & Kim, D. Y. Discordance between hip and spine bone mineral density: A point of care. Journal of Bone Metabolism,2021; 28(4): 249.

19. Lee, S. E., Park, J. H., Kim, K. A., & Choi, H. S. Discordance in Bone

Mineral Density between the Lumbar Spine and Femoral Neck Is Associated with Renal Dysfunction. Yonsei medical journal,2022; 63(2): 133.

20. Eastell, R. (1998). Treatment of postmenopausal osteoporosis. New England journal of medicine, 338(11), 736-746.

21. Aaron, J. E., Johnson, D. R., Paxton, S., & Kanis, J. A. (1989). Secondary osteoporosis and the microanatomy of trabecular bone. Clinical rheumatology, 8, 84-88.?

22. Kohrt, W. M., Snead, D. B., Slatopolsky, E., & Birge Jr, S. J. (1995). Additive effects of weight-bearing exercise and estrogen on bone mineral density in older women. Journal of Bone and Mineral Research, 10(9), 1303-1311.

23. Chan, C. Y., Subramaniam, S., Mohamed, N., Ima-Nirwana, S.,

Muhammad, N., Fairus, A., ... & Chin, K. Y. Prevalence and factors of T-score discordance between hip and spine among middle-aged and elderly Malaysians. Archives of osteoporosis,2020; 15(1): 1-11.

24. Mounach, A., Abayi, D. M., Ghazi, M., Ghozlani, I., Nouijai, A., Achemlal, L., ... & El Maghraoui, A. Discordance between hip and spine bone mineral density measurement using DXA: prevalence and risk factors. In Seminars in arthritis and rheumatism 2009; 38(6): 467-471 WB Saunders.

25. Choi, J. S., An, K. C., Lee, C. S., Choi, J. M., Kim, J. Y., & Shin, D. R. DEXA T-score concordance and discordance between hip and lumbar spine. Journal of Korean Society of Spine Surgery,2003; 10(2), 75-81.

26. Derakhshan, S., & Shahsavari, S. Discordance in diagnosis of osteoporosis using spine and femur

bone densitometry: prevalence and related factors. Iranian Journal of Nuclear Medicine, 2012;20(2), 14-19.

27. McGowan, B., McPartland, A., Silke, C., & Whelan, B. Major and minor discordance in the diagnosis of osteoporosis among Irish men and women using hip and spine dual-energy X-ray absorptiometry. 14 th Annual Research,2014; 17:155.

28. Younes M, Ben Hammouda S, Jguirim M, Younes K, Zrour S, Bejia I, et al. [Discordance between spine and hip Bone Mineral Density measurement using DXA in osteoporosis diagnosis: prevalence and risk factors]. Tunis Med. 2014;92(1):1-5.