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Effect of Lumbar Spine Osteoarthritis on Bone Mineral Density and Diagnosis of Osteoporosis in Old Men and Women

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Abstract: Background: Osteoporosis (OP) independently influences bone and cardiovascular health. A significant number of patients have a significant decrease in bone mineral density, a high risk of fracture, and a significant increase in the associated morbidity and mortality. Objective: This paper aimed to analyse the effect of lumbar spine osteoarthritis on bone mineral density and the diagnosis of osteoporosis in old men and women. Patients and methods: A cross-sectional study were conducted for patients suffering from osteoporosis in the lumbar spine, which were collected from different hospitals in Iraq for a period between January 6, 2022, to September 26, 2023, which included 85 patients whose ages ranged between 50 - 80 years. This study measured the bone mass density (BMD) of patients using dual-energy X-ray (DXA) of the lumbar spine (L1 - L4). In addition, a general assessment of the patient's bone health was conducted in terms of pain rate and the patient's quality of life. Results: Clinical results showed that those between the ages of 70 and 80 years had the highest incidence of osteoporosis in the spine, which amounted to 33 cases, as the percentage of osteoporosis in the spine reached 60% compared to female patients, which was 40%. The most prominent accompanying disease is high blood pressure. Blood by 81.36%, chronic kidney disease by 67.80%, and obesity by 84.75%, as well as the percentage of patients. Our study also found the most prominent causes of osteoarthritis in the lumbar spine, where the common causes were rheumatoid arthritis in 30 patients and repetitive pressure on the spine. In 17 patients, our study conducted a bone density test to screen for osteoporosis in patients with lumbar vertebrae (L1–L4). This result ensured that all lumbar vertebrae (L1-LL4) had osteoporosis, which decreased due to low bone density. As specified in L2 as 0.772, L1 as 0.832, L3 as 0.768, and L4 as 0.904. Conclusion: Osteoporosis in the lumbar spine has a negative impact, which causes a significant decrease in mineral density, which impairs the integrity of the spine and the bone health quality of life in elderly patients in the long term.

Keywords: Lumbar spine osteoarthritis; Bone mineral density; BMD; Quality of life; and Osteoarthritis.

INTRODUCTION

Osteoporosis (OP) is the most frequent skeletal disorder in the general population and defines a decrease in the overall mechanical strength of the bone related to an increased risk of suffering from low-impact fractures and their deleterious consequences. However, osteoporosis is usually diagnosed by the existence of a BMD measured by "Dual-energy X-ray Absorptiometry" (DEXA) below a predetermined and arbitrary limit (T-score≤-2.5 standard deviations) (Zhang, Y., & Jordan, J. M. 2010; Katz, J. N. *et al*., 2021).

Osteoporosis is a progressive and systemic skeletal disease characterized by a decrease in bone mass and deterioration in the microarchitecture of the bone, which increases its fragility and the risk of fractures (Cross, M. *et al*., 2010). It is one of the most frequent bone diseases. It is, unfortunately, a disease of generally inexpressive character, which, with the aging of a population and therefore the increase in its life expectancy, increases its risk of presence and forces to have precise and necessary criteria for an early identification if it is desired to contribute to improving the quality of life (Quintana, J. M. *et al*., 2008; Fan, Z. *et al*., 2023).

The study of bone mineral density, or bone mass, is a utopia for countless countries. This aspect is not diagnosed with a simple radiological study; the possession of the necessary equipment for this purpose is key (Jensen, R. K. *et al*., 2020).

Bone densitometry is a technique that compares the patient's bone density with the average bone density at the age of 30 to 70 years (Jensen, R. K. *et al*., 2022). The neck of the femur has been identified as the ideal anatomical site for the establishment of osteoporosis, and the result would be given by the T-Score, which expresses the deviation of bone mineral density, evaluated in terms of standard deviation units (Young, J. J. *et al*., 2022).

The possibility of developing fragility or low-impact fractures is what establishes the importance of this entity (Wang, W. J. *et al*., 2016). This defines those that occur spontaneously, caused by a trauma whose force usually would not produce a fracture, or after a fall from a height no greater than that of the patient (Chavarria, J. C. *et al*., 2021). The World Health Organization (WHO) has classified osteoporosis as one of the epidemics of this century (Diebo, B. G. *et al*., 2015).

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Osteoporotic fractures are the main consequence of this disease and are the cause of the longest hospital stays in women over 45, above breast cancer, diabetes mellitus, or myocardial infarction (Ferrero, E. *et al*., 2016). In fact, it is estimated that one in three women over the age of 50 will suffer at least one osteoporotic fracture during their lifetime; therefore, it constitutes a social, economic, and public health problem worldwide (Eneqvist, T. *et al*., 2018). The etiology and pathogenesis of bone loss in rheumatologic patients are multifactorial (Eneqvist, T. *et al*., 2017). The factors usually involved and of greater relevance are the degree of activity and the time of evolution of the disease; in the case of systemic polyarthritis, the physical inactivity to which it leads, the circulating cytokines, and the effect produced by the medication administered to control the disease, particularly corticosteroids (Mills, E. S. *et al*., 2022; Turcotte, J. J. *et al*., 2022).

PATIENTS AND METHODS

A cross-sectional study of patients suffering from osteoporosis in the lumbar spine was conducted, which included 85 patients whose ages ranged between 50 and 80 years, which collected from different hospitals in Iraq for a period between January 6, 2022, to September 26, 2023. This study identified demographic and clinical data for patients with osteoporosis of the lumbar spine, which included age, sex, body mass index, comorbidities, ASA classifications, smoking status, opioid use rate, education and employment status, economic income, and symptoms and precipitating factors for osteoporosis.

This study analyzed and designed a methodology for patient data using SPSS software, version 22.0. This study excluded patients who were less than 50 years old, pregnant women, and those who had serious or severe diseases, while the inclusion criteria included elderly patients and those who had osteoporosis in the lumbar spine.

Moreover, this study measured the bone mass density (BMD) of patients by dual-energy X-ray (DXA) of the lumbar spine (L1–L4). Dual-energy X-ray measurement is a test performed on patients for the purpose of testing the strength and health of bones. In addition, both T-scores and Z-scores were calculated for patients with osteoporosis of the lumbar spine.

For more results, this study assessed the general health quality of the patients during the follow-up period, which lasted for six months, by conducting the VAS test, which measures the extent of the patient's pain. If the score is 0, it means there is no pain at all, while if the score is 100, it means the presence of severe pain. Extremely we also assessed the quality of healthy life for patients, which ranged between (0 and 100), where 0 represents the worst quality of healthy life, and 100 represents the best quality of healthy life for patients, which determined the level of the patient's health within the four standards, which are the physical aspect, the psychological aspect, the emotional aspect, and the activity aspect. Daily for patients.

RESULTS

Table 1: Demographic and clinical characteristics of patients with lumbar spine osteoarthritis

Characteristics	Number of patients [85]	Percentage [%]
Age		
50 – 59	25	29.41%
60 – 69	27	31.76%
70 – 80	33	38.82%
Sex		
Males	51	60.0%
Females	34	40.0%
BMI, kg/m2		
28.5 – 30.0	22	25.88%
30.5 – 32.0	28	32.94%
> 32.0	35	41.18%
Comorbidities		
Non – comorbidity	26	30.59%
With comorbidity	59	69.41%
Hypertension	48	81.36%

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Chronic kidney disease	40	67.80%
Cardiovascular diseases	20	33.90%
Chronic obstructive pulmonary disease	18	30.51%
Obesity	50	84.75%
ASA classification (%)		
I	12	14.12%
II	23	27.06%
III	20	23.53%
IV	30	35.29%
Smoking status		
Yes	62	72.94%
No	23	27.06%
Chronic opioids		
Yes	34	40.0%
No	51	60.0%
Education status		
Elementary	11	12.94%
Secondary	15	17.65%
College/university	59	69.41%
Employment status		
Employed	51	60.0%
Non – employed	34	40.0%
Income status, $		
< 700	22	25.88%
700 – 900	40	47.06%
> 900	23	27.06%

Demographic results showed that patients aged between 70 and 80 years had the highest incidence of osteoporosis in the spine, which reached 33 cases, followed by patients aged between 60 and 69 years, which had 27 cases; male patients had the highest rate of osteoporosis in the spine was 60% compared to female patients, which was 40%, the rate of body mass indexes showed that patients with a body mass index between (28.5 and 30.0) were 25.88% and patients with a body mass index between (30.5 and 32.0) was 32.94%, patients with a body mass index > 32.0 were 41.18%, where the most prominent comorbidities were hypertension at 81.36%, chronic kidney disease at 67.80%, and obesity at 84.75%, as well as the percentage of patients who smoked was 72.94%, and that of non-smoking patients was 27.06%.

Table 2: Determine the basic symptoms associated with patients who suffered of lumbar spine osteoarthritis.

Symptoms	F [85]	P [%]
Lower back pain	30	35.29%
Stiffness and reduced flexibility in the lower back	16	18.82%
Pain that worsens with movement or physical activity	12	14.12%
Numbness or tingling in the legs or feet	7	8.24%
Difficulty walking or standing for long periods	3	3.53%
Decreased range of motion in the spine	17	20.00%

In addition, our findings were enrolled the common symptoms found out to the patients, which are lower back pain with 30 cases, decreased range of motion in the spine with 17 cases, stiffness, and reduced flexibility in the lower back with 16 cases

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Table 3: Determine the primary causes resulted to lumbar spine osteoarthritis**.**

Variables	**Number of patients [85]**	**Percentage [%]**
Repetitive stress on the spine	17	20.0%
Poor posture	12	14.12%
Bending or twisting	16	18.82%
Rheumatoid arthritis	30	35.29%
Metabolic disorders	10	11.76%

In this Table, our results determined the primary caused to lumbar spine osteoarthritis, where common causes were rrheumatoid arthritis had 30 patients, repetitive stress on the spine had 17 patients, and bending or twisting had 16 patients, poor posture had 12 patients, and metabolic disorders had ten patients.

Table 4: Measure bone mass density (BMD) of patients by dual-energy X-ray (DXA).

Regions	Area (cm^2)	BMC (g)	BMD (g/cm^2)
L1	11.8	9.75	0.832
L2	11.6	8.88	0.772
L3	12.92	9.95	0.768
L4	13.93	12.49	0.904
Total	50.25	41.07	0.821

Furthermore, our study conducted a bone density test to examine osteoarthritis in patients with lumbar vertebrae (L1–L4), where this result ensured that all lumbar vertebrae (L1–LL4) had osteoarthritis, which declined due to a drop in bone density, as specified in L2 with 0.772, L1 with 0.832, L3 with 0.768, and L4 with 0.904

Table 5: Determine T-score and Z–score results of patients with lumbar spine osteoarthritis.

Regions	T – score	PR (%)	Z – score	AM (%)
L1	- 1.4	84	- 0.2	97
L2	- 2.2	74	- 0.8	89
L3	- 2.8	71	- 1.5	82
L4	- 1.4	86	- 0.1	102
Total	- 2.1	78	- 0.7	92

Our outcomes found z – score was - 0.2 in L1, - 0.8 in L2, - 1.5 in L3, and – 0.1 in L4 and T – score was - 1.4 in L1, - 2.2 in L2, - 2.8 in L3, and – 1.4 in L4.

Table 6: Assessment of pain scores of patients with lumbar spine osteoarthritis during follow–up within six months.

Follow–up time (months)	**VAS Scale scores**
First month	8.5 ± 0.24
Second month	7.64 ± 0.67
Third month	5.36 ± 1.89
Fourth month	7.80 ± 0.82
Fifth month	8.10 ± 0.51
Sixth month	7.30 ± 0.24

Our findings enrolled pain scores during follow–up with six months where pain score within the first month was 8.5 ± 0.24, pain score within the second month was 7.64 ± 0.67, pain score within the third month was 5.36 ± 1.89, pain score within the fourth month was 7.80 ± 0.82, pain score within fifth month was 8.10 ± 0.51, pain score within sixth month was 7.30 ± 0.24.

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Table 7: Assessment of quality–life of patients with lumbar spine osteoarthritis during follow–up within six months.

Follow–up time (months)	VAS Scale scores
Physical function	43.11 ± 9.67
Psychological function	33.20 ± 8.76
Emotional function	38.82 ± 7.45
Activity function	20.34 ± 4.32

Our outcomes showed the quality of life related to patients with lumbar spine osteoarthritis, where the common items were physical function (43.11 ± 9.67), psychological function (33.20 ± 8.76), emotional function (38.82 ± 7.45), and activity function (20.34 ± 4.32).

DISCUSSION

Osteoporosis-induced reduction in bone mineral density (BMD) within the lumbar spine had a significant consequence that result to reducing in spinal height and the occurrence of compression fractures, which lead in significant discomfort and impairment (Lee, B. H. *et al*., 2015). These fractures caused spinal abnormalities in terms of kyphosis, characterized through a rounded and leaned forward spine, where these alterations can affect a person's level of life and general mobility. (Canseco, J. A. *et al*., 2022; Ogura, Y. *et al*., 2020)

Osteoporosis is a prevalent bone condition marked by brittle bones and a heightened vulnerability to fractures. The condition primarily impacts the lumbar spine, resulting in a notable reduction throughout bone mineral density, or BMD, within the area. The lumbar spine, formed by five vertebrae (L1–L5), is essential for supporting the upper body and enabling mobility. Osteoporosis impacting the lumbar spine compromises the skeletal system of the vertebrae, leading to a reduction in bone mineral density (BMD) (Klemencsics, I. *et al*., 2016; Holbert, S. E. *et al*., 2022).

Furthermore, a decrease in bone mineral density (BMD) within the lumbar spine had riced of the likelihood of experiencing fractures in this area but engaging in activities can placed strain on the spine in terms of moving heavy items and bending forward, as well as fractures may worsen the weakness within the lumbar spine, and persistent pain and impairment (Nolte, M. T. *et al*., 2021).

Treating osteoporosis in the lumbar spine and the resulting declined in bone mineral density typically included lifestyle changes as same as weight-bearing exercise and sufficient calcium and vitamin D intake, along with medications like bisphosphonates as well as hormone replacement therapy. Preventing falls and reducing fracture risk are essential components of managing osteoporosis on the lumbar spine (Cha, E. D. *et al*., 2022).

CONCLUSION

Our results were indicated that osteoporosis as a significant and negative impact on the lumbar spine, which results to a significant decrease in mineral density that hinders movement in the lumbar spine vertebrae (L1–L4), which causes poor and deteriorating bone health and quality of life, increases the risk of fractures, and affects spinal integrity in patients generally.

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