International Journal of Osteoporosis & Metabolic Disorders

ISSN 1994-5442

science alert

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International Journal of Osteoporosis and Metabolic Disorders 8 (1): 10-18, 2015
ISSN 1994-5442 / DOI: 10.3923/ijom.2015.10.18

Osteoporosis and Non Specific Chronic Low Back Pain: Correlation with Sex and Severity of Backache

[1]Saad M. Alzokm, [1]Aly R. Ebraheim, [1]Tarek A. Nasrallah and [2]Mostafa Shakweer
[1]Department of Rheumatology,
[2]Department of Diagnostic Radiology, Faculty of Medicine, University of Al-Azhar, Damietta, Egypt

Corresponding Author: Saad M. Alzokm, Department of Rheumatology, Faculty of Medicine, University of Al-Azhar, Damietta, Egypt

ABSTRACT

More than 80% of adults have Low Back Pain (LBP) at some time in their life. Most of the time, the exact cause of the pain cannot be found and this is called as nonspecific LBP. Relationship between OP and nonspecific chronic LBP are not clear. The aim of this study was to evaluate the association between OP and non specific chronic LBP and correlation with sex and severity of backache. One hundred patients with non specific chronic LBP and another 100 control persons without LBP were studied by DEXA and lumbosacral MRI. By DEXA 28 (28.0%) of patients and 15 (15.0%) of control having OP but by MRI 21 (21.0%) of patients and 10 (10.0%) of control having signs of OP, with significant difference between both groups (p-value 0.025 and 0.032, respectively). No significant difference between OP and severity of backache (p-value 0.146) was observed. As regard to sex 30 (69.77%) from the cases that having OP were females, while 13 (30.23%) from this cases were males with significant difference between them (p-value = 0.081). The OP is a considerable finding in non specific chronic LBP, accounting (28.0%). Most cases with OP were females and no significant difference between OP and severity of backache was found. So, it was recommended that every case of non specific chronic LBP to be evaluated by DEXA.

Key words: Osteoporosis, bone mineral density, non specific low back pain

INTRODUCTION

Low Back Pain (LBP) is extremely common-more than 80% of adults have LBP at some time in their life. Usually this is acute (short term) but it can often be chronic, lasting for weeks or even months at a time. Most of the time, the exact cause of the pain cannot be found and this is called as nonspecific LBP. Relationship between OP and nonspecific LBP are not fully clear and the search in this point is limited. Sometimes, chronic LBP may be due to micro fractures resulting from osteoporosis. Compression fractures in the back are a major source of pain and disability for women and some men, over 50 years old. Compression fractures in the back are also the most common type of fracture due to osteoporosis. A vertebral fracture also increases the chance of other future fractures such as a hip fracture. Osteoporosis treatment significantly reduces the chance of future fractures (Palmer *et al*., 2000).

Osteoporosis is the most common type of metabolic bone disease characterized by low bone mass and micro architectural deterioration. It results either from the body's inability to form new bone

or from an increased resorption of formed bone. Essentially, when there is an imbalance between osteoblastic and osteoclastic activity, skeletal problems may arise. Osteoporosis is a disease of bones that leads to an increased risk of Fracture (Brian *et al*., 2009). In osteoporosis, the Bone Mineral Density (BMD) is reduced and bone microarchitecture is deteriorated. Osteoporosis by the World Health Organization (WHO) defines as a bone mineral density that is 2.5 (standard deviation) or more below the mean peak bone mass (average of young, healthy adults) are measured by Dual energy X-ray absorptiometry (DEXA); the term "Established osteoporosis": Include the presence of a fragility Fracture (WHO., 1994). Primary osteoporosis occurs in postmenopausal and secondary osteoporosis may arise at any age and affects men and women equally results from chronic predisposing, medical problems or disease or prolonged use of medications (Old and Calvert, 2004).

Several diagnostic techniques have improved for diagnosis of osteoporosis, most notably Dual-energy X-ray Absorptiometry (DEXA) which is recognized as the reference method to measure bone mineral density (BMD).

The World Health Organization (WHO., 1994) has established DEXA as the best densitometric technique for assessing BMD. DEXA allows accurate diagnosis of osteoporosis, estimation of fracture risk and monitoring of patients undergoing treatment. It can be completed in about 15 min with minimal radiation exposure (about one tenth that of a standard chest x-ray for a quick hips and spine exam).

The WHO define osteoporosis on the basis of the T-score (which is the difference between the measured BMD and the mean value of normal young adults, expressed in Standard Deviations (SD) for a normal population of the same ethnicity) and the diagnostic criteria are, osteoporosis in terms of a T-score below -2.5 and osteopenia when T-score is between -1 and -2.5 (WHO., 1994).

More recently, attention has been focused on deriving measures that provide information about not only bone mineral density but also microstructure. Magnetic resonance imaging (MRI) and Computed Tomography (CT) are such techniques which potentially may provide information pertaining to bone density and structure as well as to occult fracture detection. For example, quantitative CT (QCT), peripheral QCT and quantitative MRI are promising tools for the measurements of the bone density. Micro-CT and magnetic resonance microscopy are potentially available tools to image and quantify the three-dimensional structure of trabecular bone. Magnetic Resonance Imaging (MRI) also has been used to assess risk of fracture (Ishida and Kawai, 2001).

The aim of this study was to evaluate the association of OP with non specific chronic LBP and to evaluate the correlation of OP with sex of the patients and severity of LBP.

MATERIALS AND METHODS

Subjects: The case-control observational study was conducted at Rheumatology and Radiology Departments, Al-Azhar University Hospital, Damietta, Egypt, from February 2013 to October 2014. It comprised 100 adult patients (50 males and 50 females) having non specific chronic LBP for more than 12 weeks. Another 100 healthy subjects (50 males and 50 females) without LBP were employed to act as the control group. The patients and control group were adult subjects of either gender. Informed consent was obtained from all of them. Patients and control groups were selected so that age, body weight and height were matching. All persons having the following inclusion and exclusion criteria.

Inclusion criteria:

- Age ranged from 20-50 years
- Average height and weight
- All females must be pre-menopausal

Exclusion criteria: All persons with the following disorders will be excluded from the study:

- Endocrinal disease such as diabetes mellitus and hyperthyroidism
- Chronic liver and renal disease
- Malignancy
- Smoking and alcoholism
- Morbid obesity
- Collagen diseases as rheumatoid arthritis, systemic lupus and scleroderma
- Known causes of LBP as seronegative spondyloarthropathy, spondylosis, spondylo-litheses, infection, malignancy, disc herniation or prolapse, congenital anomalies and traumas

Methods

Pain Visual Analogue Scale (VAS): To measure LBP intensity for the cases by using a ruler, the score is determined by measuring the distance (mm) on the 10 cm line between the "No pain" anchor and the patient's mark, providing a range of scores from 0-100. A higher score indicates greater pain intensity. Based on the distribution of pain VAS scores, pain intensity classified as none, mild, moderate or severe, the following cut points on the pain VAS have been recommended: No pain (0-4 mm), mild pain (5-44 mm), moderate pain (45-74 mm) and severe pain (75-100 mm) (Aun *et al*., 1986).

Lumbosacral magnetic resonance imaging (MRI): Using 1.5 tesla Philips closed system), MRI examination was started by explanation of the procedure to the patient to minimize claustrophobia or gross motion. The typical MRI examination were both T1 and T2 weighted images in both axial and sagittal planes. The TI-weighted sequence was performed using TR 400 msec, TE 11I msec, matrix 512×384, slice thickness 4.4 mm, interslice gap 0.4 mm, field of view 325 mm, acquisition time 4 min 24 sec. The T2-weighted sequence was performed using TR 3500 msec, TE 120 msec, matrix 512×384, slice thickness 4.4 mm, interslice gap 0.4 mm, field of view 325 mm, acquisition time 3 min 54 sec. T2 weighting enhances the signal of the cerebrospinal fluid and makes this series more sensitive to spinal disease; the fast spin echo sagittal image was used to assess the central canal and thecal sac compromise by osteophyte or disk. As fat produces an intense signal that can obscure the image, this signal was suppressed by adding a fat-suppression pulse to a spin echo sequence on fatty lesion. The role of MRI in this study to help in exclusion of cases of disc herniation or prolapse, malignancy, infection and to assess the bone density, micro fracture and Shmorl's nodules as a signs of osteoporosis.

Dual Energy X-ray Absorptiometry (DEXA): A full table system (capable of multiple skeletal measurements, including the spine and hip) was used. The full table DEXA scanners use a fan-beam source and multiple detectors, the fan beam provides the advantage of decreased scan times compared to single-beam systems. The patient was placed on a table in the path of the radiation beam between the radiation source and detector, the detector placed directly opposite the

site to be measured. The source/detector assembly was then scanned across the measurement region. The attenuation of the radiation beam was determined and is related to the Bone Mineral Density (BMD). BMD was the measured parameter and allows the calculation of the Bone Mineral Content (BMC) in grams and the two-dimensional projected area in cm^{-2} of the bone(s) being measured; thus the units of BMD were $g\ cm^{-2}$. The osteoporosis was defined on the basis of the T-score (which is the difference between the measured BMD and the mean value of normal young adults, expressed in Standard Deviations (SD). The T-score was calculated using the formula:

$$\frac{\text{Patient's BMD-Young normal mean}}{\text{SD of young normal}}$$

according to the value of T-score the results was as following: Normal BMD when T-score more than -1, osteopenia when T-score was between -1 and -2.4 and osteoporosis when the T-score equal or less than -2.5.

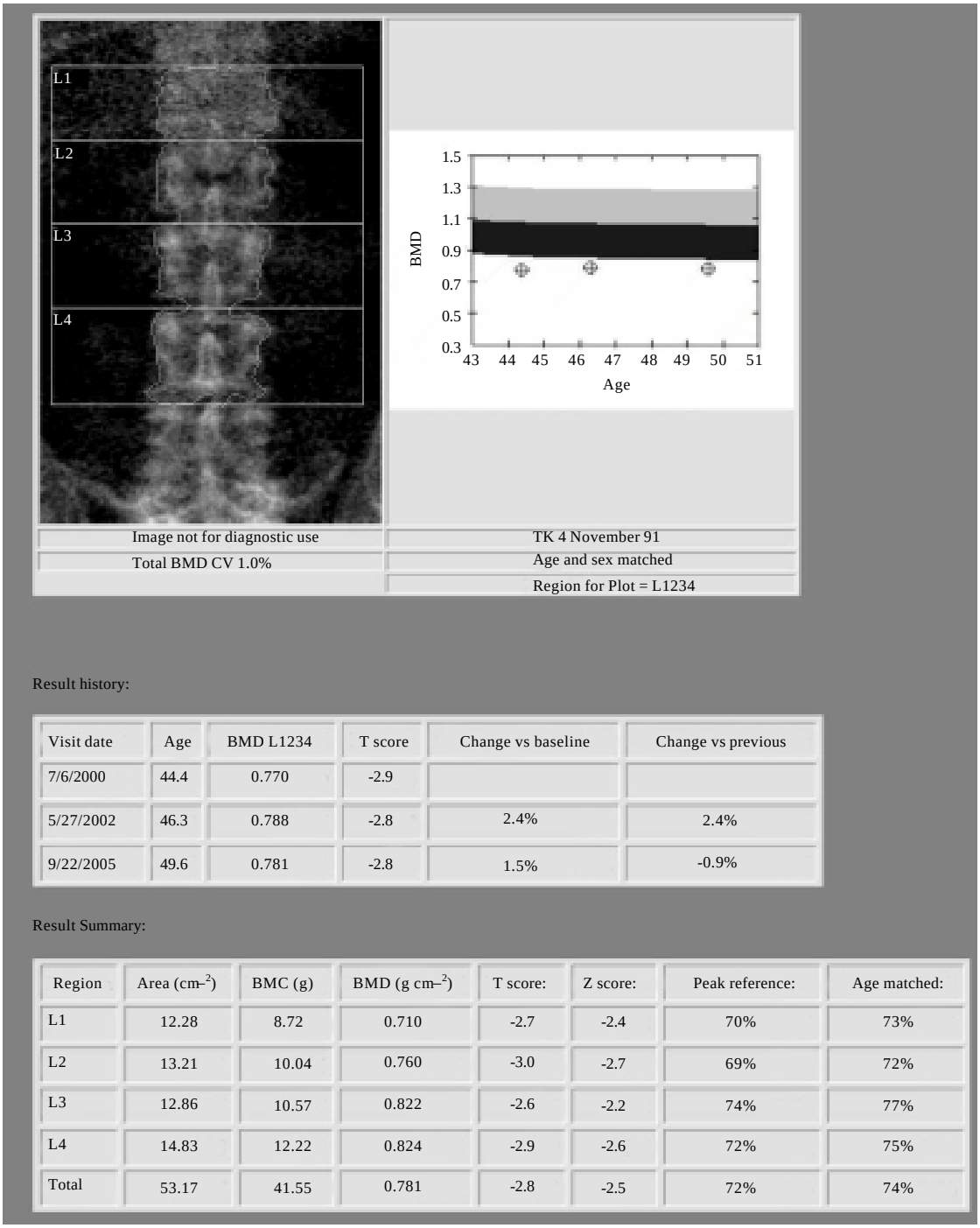
Statistical analysis: The collected data was organized tabulated and statistically analyzed using SPSS (Statistical Package for Social Science) software compute program version 12 (SPSS Inc, USA). The results were represented in tabular forms then interpreted. Mean, standard deviation, range, frequency and percentage were used as descriptive, chi square and Fisher exact test was used for testing significance of observed differences between studied patients. The level of significance was adopted at $p<0.05$.

RESULTS

Table 1 shows that by DEXA 28 (28.0%) of patients and 15 (15.0%) of control having OP but by MRI, 21 (21.0%) of patients and 10 (10.0%) of control having signs of OP. Figure 1 shows the lumbar spine bone mineral density measures through DEXA Scan while Fig. 2 shows MRI of lumbosacral spine showing Shmorl's nodules. As regard DEXA and MRI (Table 2) there are significant difference between patients and control cases (p-value 0.025 and 0.032, respectively).

Table 1: Distribution of the cases regarding to DEXA, lumbosacral MRI and VAS

	Patients = 100		Control = 100	
Parameters	N	%	N	%
DEXA (mean T score)				
Normal BMD (>-1)	14	14.0	65	65.0
Osteopenia (-1 to -2.4)	58	58.0	20	20.0
Osteoporosis (= -2.5)	28	28.0	15	15.0
lumbosacral MRI (signs of OP)				
With signs of OP	21	21.0	10	10.0
Bone marrow edema	12	12.0	6	6.0
Shmorl's nodule	9	9.0	7	7.0
Micro fracture of the spine	18	18.0	2	2.0
Without signs of OP	79	79.0	90	90.0
VAS				
No pain (0-4 mm)	0	0.0	100	100.0
Mild pain (5-44 mm)	28	28.0	0.0	0.0
Moderate pain (45-74 mm)	14	14.0	0	0.0
Sever pain (75-100 mm)	58	58.0	0	0.0



Result history:

Visit date	Age	BMD L1234	T score	Change vs baseline	Change vs previous
7/6/2000	44.4	0.770	-2.9		
5/27/2002	46.3	0.788	-2.8	2.4%	2.4%
9/22/2005	49.6	0.781	-2.8	1.5%	-0.9%

Result Summary:

Region	Area (cm^{-2})	BMC (g)	BMD (g cm^{-2})	T score:	Z score:	Peak reference:	Age matched:
L1	12.28	8.72	0.710	-2.7	-2.4	70%	73%
L2	13.21	10.04	0.760	-3.0	-2.7	69%	72%
L3	12.86	10.57	0.822	-2.6	-2.2	74%	77%
L4	14.83	12.22	0.824	-2.9	-2.6	72%	75%
Total	53.17	41.55	0.781	-2.8	-2.5	72%	74%

Fig. 1: (DEXA scan): The lumbar spine bone mineral density measures. Based on the WHO, diagnostic categories for osteoporosis, the lowest T score of -2.8 in the lumbar spine indicates osteoporosis

Fig. 2: Lumbosacral spine MRI (T1 and T2) showing Shmorl's nodules (Protrusions of the cartilage of the intervertebral disc through the vertebral body endplate and into the adjacent vertebra, due to osteoporosis)

Table 2: Comparison between patients and control groups as regard OP by DEXA and lumbosacral MRI

	Patients = 100		Control = 100		
Parameters	N	%	N	%	p-value
DEXA (mean T score)					
OP	28	28.0	15	15.0	0.025 S*
Lumbosacral MRI (as regard signs of OP)					
With signs of OP	21	21.0	10	10.0	0.032 S*

S*: Significant

Table 3: Correlation between OP by DEXA and severity of LBP (VAS)

	No pain = 100		Mild LBP = 28		Moderate LBP = 14		Sever LBP = 58		p-value
Parameters	N	%	N	%	N	%	N	%	0.14 6
OP cases patients + control = 43	15	34.88	10	23.26	8	18.60	10	23.26	NS**

NS**: Non significant

Table 3 represents that 28 (28.0%) of patients having mild LBP, 14 (14.0%) having moderate LBP and 58 (58.0%) having sever LBP. From the cases of OP, 15 (34.88%) from 43 haven't backache, 10 (23.26%) having mild backache, 8 (18.60%) having moderate backache and 10 (23.26%) from them having sever backache, without significant difference between OP and severity of LBP (p-value 0.146).

Table 4 represents that 19 (67.86%) from the patients that having OP and 11 (73.34%) from the control that having OP (totally 30 (69.77%)) were females, while 9 (32.14%) from the patients that having OP and 4 (26, 66%) from the control that having OP (totally 13 (30.23%)) were males with significant difference between them (p-value = 0.081).

Table 4: Correlation between OP by DEXA with sex of cases

	Male = 100		Female = 100		
OP cases	N	%	N	%	p-value
Patients = 28	9	32.14	19	67.86	0.012 S*
Control = 15	4	26.66	11	73.34	0.031 S*
Total = 43	13	30.23	30	69.77	0.081 S*

S*: Significant

DISCUSSION

The results of this study revealed that 28.0% of the cases of non specific LBP had OP by DEXA and 21.0% had signs of OP by MRI and there is significant difference between patients and control cases. There results are in agreement with (Manabe *et al*., 2003), in a cross-sectional study, who investigated 2,244 women, aged 25-85 years and found that LBP, is associated with lower BMD, concluding that low BMD is an important cause for LBP pain and disabilities. In addition (Snider *et al*., 2011), studied 63 individuals, 16 of them had LBP and showed that patients with LBP had significantly lower BMD values at the lumbar spine in comparison to the individuals without LBP.

On the other hand and against result of the present study (Atlas and Deyo, 2001), had been reported that low BMD detected by both plain radiographs and advanced imaging studies are poorly associated with LBP.

The present research also revealed that, all the cases (100.0%) that had signs of OP by MRI had also OP by DEXA. But some cases (8.9%) that hadn't signs of OP by MRI, had OP by DEXA. So, DEXA is more sensitive than MRI in diagnosis of OP and it had an advantage for diagnosis of osteopenia than MRI.

This results in agreement with (Balague *et al*., 2012), that reported that MRI had the advantage of not using ionizing radiation and providing better resolution and provides diagnostic accuracy similar or better than other modalities. However, it has the disadvantage of osteopenia diagnosis.

Putting in mind that, BMD is the most general indicator to diagnose osteoporosis and determine for its treatment and the most important factor to predict osteoporotic fracture. It certainly has weakness that there may be measurement error due to two-dimensional imaging and it cannot reflect bone quality. Yet, it is the most widely used in a clinical setting because the criteria of osteoporosis and osteopenia defined by the WHO are based on BMD (Fujiwara *et al*., 2003).

Combining advantage and disadvantages of both studied imaging techniques and taking into consideration the higher sensitivity of MRI in relation to DEXA, it is advisable to use DEXA in collaboration with MRI in cases with non specific LBP. When MRI facilities are not available, DEXA alone can be a useful diagnostic tool of OP in cases of LBP.

Also in this study most patients had severe LBP (58.0%) and there was no significant difference between OP and severity of LBP (p-value 0.14 6) and this result in agreement with (Yuan *et al*., 2011), that reported no evidence for any direct relationship between the two has been found. Although most people believe that OP will lead to LBP, it usually occurs after a vertebral fracture. In contrast one study in Japan (Manabe *et al*., 2003), showed a positive relationship between BMD and LBP and another study (Makhdoom *et al*., 2014), concluded that decreased BMD was noticed with increasing severity of chronic back pain.

Also this study shows that 30(69.77%) from the cases who were having OP were females, while 13(30.23%) were males with significant difference between them (p-value = 0.081). This result in agreement with (Yuan *et al.*, 2011).

Risk factors for LBP are poorly understood: the most frequently reported are heavy physical work; frequent bending, twisting, lifting, pulling and pushing; repetitive work; a static posture and vibrations. Psychosocial risk factors include anxiety, depression, job dissatisfaction and mental stress at work. Several risk factors related to inactivity or immobilization was proposed: Reduced muscle strength in the back, abdominal and thigh muscles; reduced endurance in back muscles; hyper mobility of the lumbar column and hypo mobility of hip joints (Hilde and Bo, 1998). Genetics is likely to play a significant role in the development of the processes leading to LBP (Battie *et al.*, 1995). Physical activity (PA) may have dual roles as positive and negative influences on the back (Videman *et al.*, 1995). Prolonged heavy occupational and sports activities seem to increase the risk of LBP but the role of subclinical or more-severe injuries cannot completely be excluded.

Besides physical therapy, many studies suggested vertebroplasty as a treatment of osteoporotic compression fractures. It is a minimally invasive procedure performed to treat both acute and chronic severe back pain associated with vertebral compression fractures. The procedure involves injecting cement into the collapsed vertebral body and can be used to treat a number of underlying causes, including OP, osteonecrosis, painful hemangiomas and malignancies (i.e., pathologic fractures). Most of the published data on vertebroplasty have been favorable (McGirt *et al.*, 2009). Benefits derived from vertebroplasty include pain relief, increased mobility and increased function. Vertebroplasty is indicated in cases of localized pain that impedes function and activities of daily living, where medical treatment either has failed or is contraindicated.

The limitation of this research is due to limited number of the patients because of decrease in the financial supplementation.

CONCLUSION

OP is usually asymptomatic in the beginning with non-specific symptoms. In later stages, people often suffer from complications from fractures including LBP. Because OA and OP may coexist in aging societies, either high BMD or low BMD may be possible in patients complaining of LBP. The OP is a considerable finding as a cause of non specific LBP, accounting for about 28% of the cases. DEXA is more sensitive than MRI in diagnosis of cases of OP. DEXA alone can be a good diagnostic tool in diagnosis of OP in absence of MRI. No significant difference between OP and severity of backache was observed and most cases of OP were females. It was recommended that every case of non specific chronic LBP to be evaluated by DEXA. More efforts should be extended in getting a thorough history and study.

ACKNOWLEDGMENT

We are grateful to Professor, Hesham El-Desoky, University of Al Azhar, Faculty of medicine, Damietta, Egypt.

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