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Original article

Evaluation of Osteoporosis in Sickle-Cell Patients by Using Dual- Energy X-ray Absorptiometry in Selective Hospital

Mona Elhaj

Department of Radiological Sciences, College of Applied Medical Sciences, Taif University, P.O.Box 11099, Postal Code 21944, Taif , Saudi Arabia.

*Corresponding author: Mona Elhaj; *Mesheekh@tu.edu.sa*

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Abstract

The study was attempted to evaluate osteoporosis in sickle-cell patients in the eastern province of Kingdom of Saudi Arabia by Using Dual-Energy X-ray Absorptiometry (DEXA). About 50 patients between 32 and 62 years old were taken as a sample size from Mouwasat Hospitals at Dammam and Qatif cities, who underwent for hip and spine DEXA scan. This research was a descriptive study which include 50 sickle cell patients who had gone under DEXA scan between January, 2016 and January, 2019. The study used simple sample randomization to obtained required data. The result of this study depending on mean BMD and T-score for both spine and hip region indicate osteoporosis. Osteoporosis was distributed as 86 % of female and 14% males of all participants. The incidence of osteoporosis at the spine was higher than hip which represented 56% of all osteoporosis cases. Additionally, the prevalence of osteoporosis among SCD patients increase with age; with the highest frequency recorded for participants aged between 52-62. Finally, only 16% of all participants reported a total hip joint replacement which was a poor result. The result of this study may not be validated in that it only included minimal portion of sickle cell patients in a short time. Further studies are recommended to develop this research and expand its findings.

Keywords: ***Sickle-Cell, Dual- Energy X-ray, Osteoporosis***

Introduction

Osteoporosis, can be defined as a condition of low bone mass which normally result in increased fracture risk. The diseases had been affected around 10 million in the Middle East. It is estimated that the ageing population would be projected to contribute to approximately 50 percent increase in Osteoporosis incidence by the year 2025 (Özen et al., 2013). Osteoporosis is widespread but can be generally asymptomatic, even without detection and prevention, the costs of osteoporotic fracture-related death and morbidity will be a significant issue for the World Health Organization (Akesson et al., 2011). This is a mainly relevant in diminishing the health services and care. The most accurate and reliable technique for determining bone mineral density (BMD) and identifying osteoporosis is dual-energy X-ray absorptiometry (Arlet et al., 2013).

Cost-efficiency analyses support timely diagnosis and treatment of the high-risk patients especially sickle cell patients with anti-restorative medicines such as the bisphosphonates (Elliott, 2011). Furthermore, optimization of the bone fitness all through life can assist in preventing osteoporosis (Özen et al., 2013). The stated guidelines recommend examining those who are 65 years of age and older, but because there are no protocols for screening interruptions, decisions are taken solely based on patient assessment (Arlet et al., 2013). Even though the current literature offers some guidance, this research will further explore current screening of osteoporosis using DEXA method in light of much recent data to give more transparency on stoppage, screening, and the management plans for osteoporosis patients in the Saudi Arabia region.

Previously believed to be a natural aspect of ageing, osteoporosis is now considered as a preventative and treated condition (NIH, 2000). Numerous strategies may be employed for both primary and secondary prevention to lower the risk of fractures in the normal community. These include avoiding trip or fall risks, antiresorptive treatment, weight-bearing exercise, nicotine abstention, alcohol drinking, and an appropriate combined calcium and vitamin D consumption (calcium alone has not been proved to decrease fractures) (NOF, 2010). Exercise has been shown in several studies to have positive health effects, such as a lower incidence of fractures and injuries. For the purpose of preventing osteoporosis, weight-bearing and muscular exercise is advised since it enhances balance, posture, flexibility, and endurance (NOF, 2010). Doctors must consider this when recommending the kind and intensity of activities for some patients since exercise raises their risk of fractures and falls. 43 randomized controlled studies that examined whether exercise helped stop bone loss and injuries in postmenopausal women were included in a recent Cochrane review. Exercise had a negligible but numerically substantial impact on BMD. The best activity for femur neck BMD was particularly non-weight-bearing, high-force exercise (such as lower-limb, sequential endurance training) (Howe et al., 2011).

This research study aims to expands and develops the knowledge available about the usage of DEXA to evaluate the osteoporosis in sickle cell patients in the Kingdom of Saudi Arabia. This is because nearly non-related data available universally about the occupation of this problem within the Kingdom. (i) To identify low bone density and osteoporosis among the sickle cells patients by

using mean values of BMD and T-score. (ii) To estimate the incidence of osteoporosis in SCD patients among sex and according to affected region. (iii) To identify the frequency of osteoporosis occurrence in comparison with osteopenia and normal result for SCD patients at spine, hip among sex and age groups. (iv) To identify the percentage of SCD participants who underwent total joint replacement surgery.

Materials and Methods

Study Design

This research was a distributive study which include sickle cell patients who had gone under DEXA scan between January, 2016 and January, 2019. The study used a simple sample randomization to obtained as much needed data. This study was conducted at radiology department in both Mouwasat Hospitals at Dammam and Qatif cities, during the period from February to April, 2019.

The population of this study was consisted of sickle cell (SCD) patients between the age of 32 and 62 who underwent DEXA scan in the period between January, 2016 and January, 2019. The study sample size was (50) SCD patients of both Mouwasat Hospitals at Dammam and Qatif cities.

Inclusion and Exclusion criteria

The study inclusion criteria were SCD patients of both gender; between the age of 32 and 62 who underwent DEXA scan in the period between January, 2016 and January, 2019. Non-sickle cell patients who had gone under DEXA procedure and SCD patients who had not gone under DEXA procedure was excluded from the study.

Study Variables and data collection method

This study had the following dependent and independent variable: The dependent variables of this study were DEXA scan results including total T-score and BMD of both spine and hip regions. The independent variables of this study were participants' sex, weight and age.

The data was collected by a data collecting sheet and a questionnaire; which were designed by the researchers, to include and organize the study variables. The researchers also accessed to both hospitals' data bases to verify data. The medical imaging modality used in this study was GE Lunar iDXA scanner. GE Lunar iDXA scanner cockered to be a central DEXA device.

Examination technique and protocol

Like some other ionization densitometry methods, DXA starts with a scouting or pilot radiography image to ascertain the proper location and screen for artefacts before gathering data. Following analysis of the selected sites, a bone mineral report is prepared. The scanned anatomical part's bone mineral images, bone density measurement, a comparative of young and age-matched normal distributions with the same sex and race, clinical records, and quality assurance data are often included in this report. The assessment is subsequently made by comparing the information gathered with database systems of bone density. Current clinical therapy frequently employs a method called dual-energy x-ray absorptiometry (DXA). The application of a high- and low-energy x-ray beam to measure the areal mass of tissues is included into the physical foundation of DXA. Rare earth filters or a power switching system (pulsing) might be used to achieve this. Systems for switching energy back and forth between high and low kilovoltages. The x-ray beam is divided into functional high and low energies using filters in combination with energy discrimination detection devices (Lampignano et al., 2014).

The patient should be scheduled at least a week after the date of any prior radiographic contrast examination or with administration of any isotopes for a nuclear medicine study. The patient is advised to put on loose clothes and avoid carrying anything heavy (e.g., belt, zipper in the abdomen and pelvic area). To achieve an artefact-free collection, departmental guidelines may stipulate that the patient undressed and wearing a robe throughout the process. The patient to lie supine on the examination couch with the midsagittal plane align with the couch midline. Patient's legs must be extended and rotated internally while both femoral necks parallel to the imaging surface (Lampignano et al., 2014).

Data analysis

The data was analyzed by researchers themselves; using both Microsoft Office Excel and Apple iOS Number programs.

Ethical considerations

This study will take ethical directions into consideration. First of all, researchers will obtain legal authority from hospital as well as the college board, in order to conduct research. After which the researcher will be embarked on delivering high-quality research. In order to produce a high quality and reliable results, the researcher with approach the patients and collect firsthand information, the patients will be requested to sign consent form before taking part in the study. All the study participants will be guaranteed confidentiality. All the information provided by the patients will be kept secretly as well as key-and-lock. Patients will be ensured that their identities will be kept as secrets.

Results and Discussion

The study was attempted to estimate the prevalence of osteoporosis among SCD patients on the eastern province of Saudi Arabia population. 50 patients between 32 and 62 years old were taken as a sample size from Mouwasat Hospitals at Dammam and Qatif cities, who underwent for hip and spine DEXA scan.

Table 1: The frequency of osteoporosis in SCD patients among sex.

Sex	Total participant number
Female	43
Male	7

Table 2: The frequency of osteoporosis occurrence in comparison with osteopenia and normal result for SCD patients at spine among sex.

Diagnosis / Sex	Osteoporosis	Osteopenia	Normal
Female	29	9	4
Male	3	4	1

Table 3: The frequency of osteoporosis occurrence in comparison with osteopenia and normal result for SCD patients at hip among sex.

Diagnosis / Sex	Osteoporosis	Osteopenia	Normal
Female	20	19	4
Male	5	2	0

Table 4: The frequency of osteoporosis occurrence in SCD patients at spine among age group.

Age group	Frequency of osteoporotic spine patients
(32-42)	5
(42-52)	2
(52-62)	24

Table 5: The frequency of osteoporosis occurrence in SCD patients at hip among age group.

Age group	Frequency of osteoporotic hip patients
(32-42)	4
(42-52)	6
(52-62)	15

Table 6: The mean BMD and mean T-score of all SCD participants in both spine and hip regions.

Mean value / Region	BMD	Diagnosis	Total T-score	Diagnosis
Spine	0.810	Low	-2.5	Osteoporosis
Hip	0.791	Low	-2.5	Osteoporosis

Table 7: The frequency of osteoporosis occurrence in SCD patients according to affected region.

Region	Osteoporosis occurrence frequency
Spine	32
Hip	25

Table 8: The frequency of SCD participants who underwent total joint replacement surgery.

	Hip	No data
Frequency	8	42

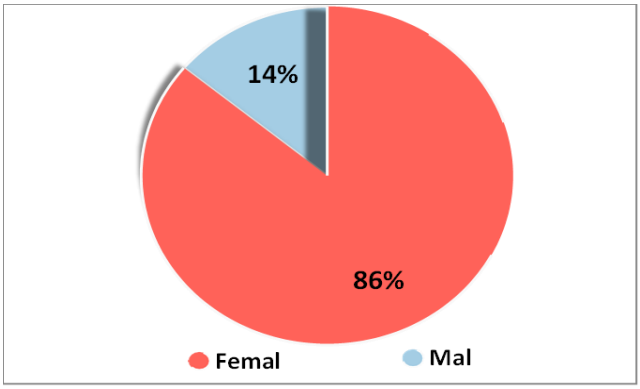

Figure 1: The incidence of osteoporosis in SCD patients among sex.

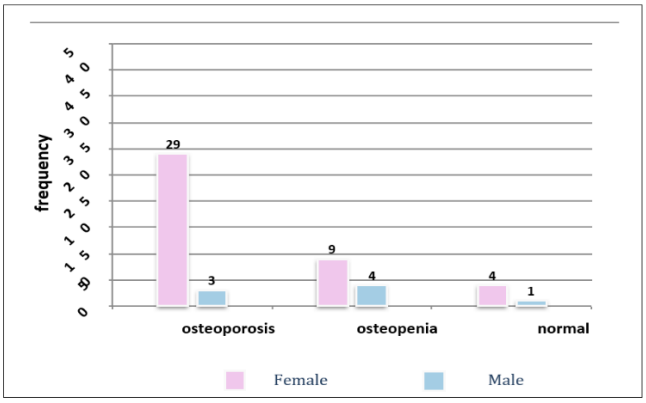

Figure 2: The frequency of osteoporosis occurrence in comparison with osteopenia and normal result for SCD patients at spine among sex.

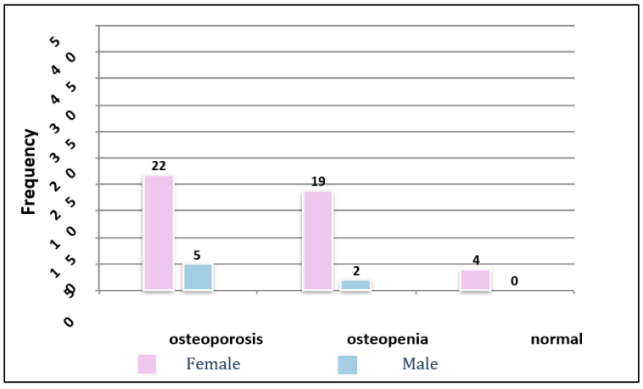

Figure 3: The frequency of osteoporosis occurrence in comparison with osteopenia and normal result for SCD patients at hip among sex.

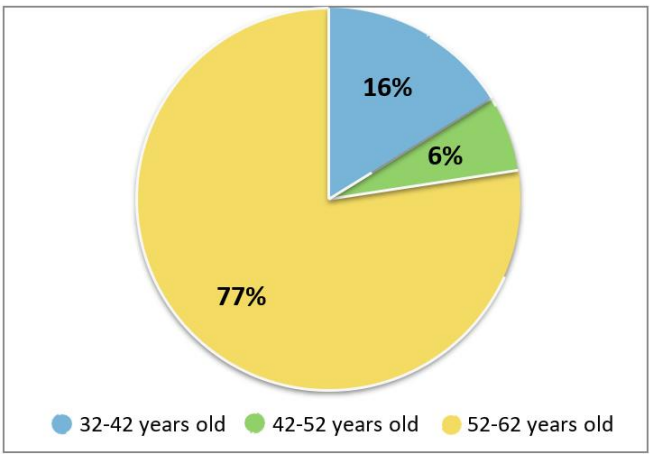

Figure 4: The incidence of osteoporosis occurrence in SCD patients at spine among age group.

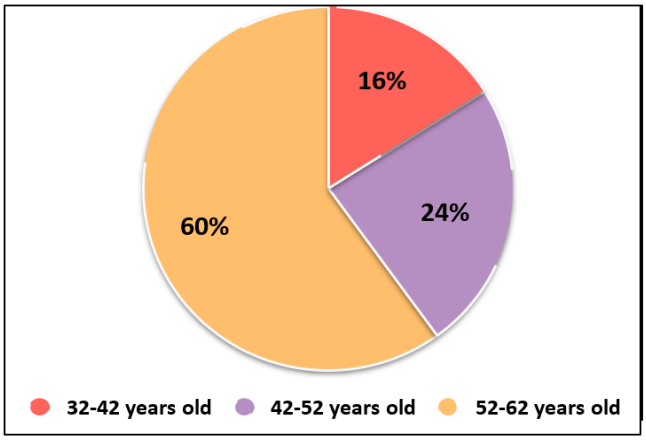

Figure 5: The incidence of osteoporosis occurrence in SCD patients at hip among age group.

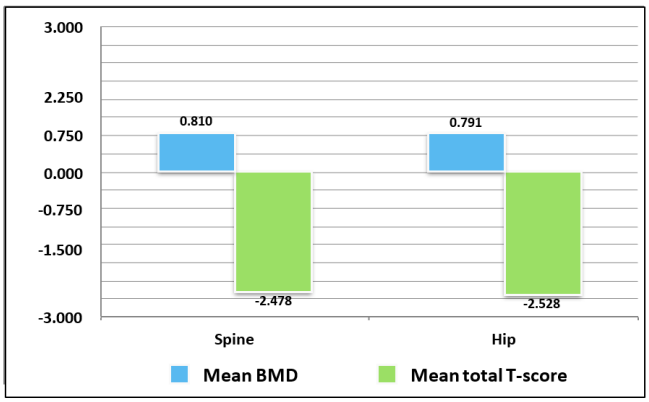

Figure 6: The mean BMD and mean T-score of all SCD participants both spine and hip regions

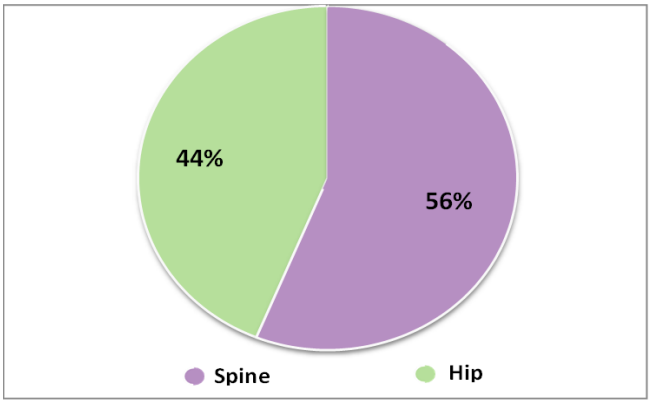

Figure 7: The incidence of osteoporosis occurrence in SCD patients according to affected region.

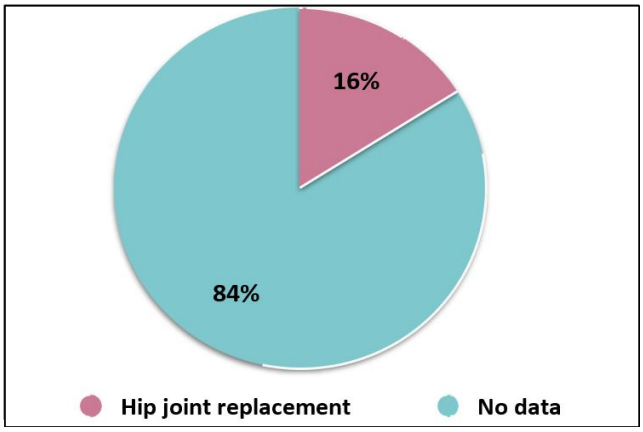

Figure 8. The percentage of SCD participants who underwent total joint replacement surgery.

The prevalence of osteoporosis in a random sample was distributed as 86 % of female and 14% males (Table 1; Figure 1). Among a number of 50 patients, the prevalence osteoporosis at the spine was higher in female and minimal in male. Osteoporosis spine patients were 29 females and three males. Osteopenia spine patients were in nine females and four males. Four females and a male had reported normal spine score (Table 2; Figure 2). Similarly, the prevalence osteoporosis at the hip was higher in female and lesser in male. Osteoporosis hip patients were 22 females and five males. Osteopenia hip patients were in 19 females and two males. Four females and no male had reported normal hip score (Table 3; Figure 3). SCD female patients are more prone to osteoporosis in Saudi Arabia could be because of hormonal and sociocultural factor that can cause vitamin D deficiency which is associated with low BMD. This was supporting the results of Özen et al. (2013) and Arlet et al. (2013).

The relationship between age and osteoporosis was directly proportional, which was showing that an increase in age lead to an increase of osteoporosis incidence in SCD patients. Among osteoporotic spine patients, patients between 42 and 52 reported the Least score (6%) whereas patients between 52 and 62 reported 77% of osteoporotic spine score (Table 4; Figure 4). Similarly, among osteoporotic hip patients, patients between 32 and 42 reported the Least score (16%) while patients between 52 and 62 reported 60% of osteoporotic hip score (Table 5; Figure 5). These results were supporting Waugh (2018) findings. Normally, the BMD decrease after the age of 35 unless there was a pathologic or genetic factor (Waugh, 2018). Therefore, Osteoporosis can be occurred earlier for SCD patients. Additionally, this were similarly revealed by Özen et al. (2013) and Elliott (2011). BMD, which can control Osteoporosis result, affected by the ageing process as ageing can affect the endocrine system like what happen in postmenopausal age in females.

There is variation between BMD and T-score in diagnosis in both spine and hip region. The result of mean BMD for both hip and spine indicates a low bone density diagnosis (Table 6) (Figure 6). The mean T-score for both regions was about -2.5 which indicates the diagnosis of osteoporosis (Table 1; Figure 1). This was agreeing with Elliott (2011) findings. Osteoporosis can result from factors that cause low bones density such as genetic factors; Hence, SCD cause Osteoporosis on long term.

There was a frequency variation of osteoporosis in SCD patients according to affected region, the highest score was recorded at the spine that is 32 which represents 56% of all participants. The hip region had recorded the lowest frequency of 25 represents 44% of all participants (Table 7; Figure 7). This was supporting Elliott (2011) results. There was high incidence of osteoporosis at the spine which on long term can result in osteoporotic fracture.

Finally, there was some SCD participants who underwent total joint replacement surgery. Among the 50 study participants, only eight patients had undergone hip joint replacement (Table 8; Figure 8). This were similarly found by Jonior et al. (2012) and Vaishya et al (2015). Osteoporosis can result in osteonecrosis at area like hip which may require surgical treatment. However, total joint replacement surgery was poorly studied this study which is also supported by other studies that revealed osteoarticular involvement with sickle cell patient was poorly studied Vaishya et al (2015).

Conclusion

This study was done to Evaluate osteoporosis in sickle-cell patients in the eastern province of Kingdom of Saudi Arabia by Using Dual-Energy X-ray Absorptiometry (DEXA). The study involved a random sample of 50 SCD patients aged between 32 and 62 years old. The result of this study depending on mean BMD and T-score for both spine and hip region indicate osteoporosis. Osteoporosis was distributed to be more in female rather than male's participants. The incidence of osteoporosis at the spine was higher than hip which represented more than half of all osteoporosis cases. When comparing osteoporosis occurrence with osteopenia and normal result for SCD patients at spine region, osteoporosis female patients wherefore than males, osteopenia female patients were more than males; and few females and a male had reported normal spine score. Similarly, when comparing osteoporosis occurrence with osteopenia and normal result for SCD patients at hip region, o osteoporosis female patients wherefore than males, osteopenia female patients were more than males; and few females and no male had reported normal hip score. Additionally, the prevalence of osteoporosis among SCD patients increase with age at both spine and hip regions; with the highest frequency recorded for participants aged between 52-62. Finally, only minimal portion of all participants reported a total hip joint replacement which was a poor result. DEXA scan is an accurate affective procedure to diagnose osteoporosis among SCD patients indicating that osteoporosis is widely affecting SCD patients; which retain the first and second study hypothesizes. However, surgical joint replacement for osteoporotic sickle cell patients was poorly studied at this study which rejects the third hypothesis of this study.

Ethics approval and consent to participate

Project No:0017/2020 Project title: Evaluation of Osteoporosis in Sickle-Cell Patients by Using Dual- Energy X-ray Absorptiometry in Selective Hospital Principal Researcher: Dr. Mona Elhaj Was reviewed by the Scientific Research and Ethics Committee and met the requirements of the Ethical Committee and was thus granted an UNCONDITIONAL APPROVAL on 2nd March 2020

List of abbreviations

DEXA: Dual-Energy X-ray Absorptiometry
BMD: Bone Mineral Density
SCD: Sickle-Cell Disease

Conflicts of Interest

There is no conflict of interest regarding the publication of this paper.

Funding Statement

There is no funding for this research.

Authors' contributions

This search is individual

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