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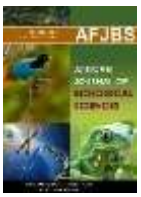

Prevalence of osteoporosis and osteopenia in females of Sulaymaniyah city, Kurdistan Region of Iraq

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Abstract

Osteopenia is a clinical term referring to the condition of decreased bone mineral density which reflects the underlying damage occurring in the microarchitecture of the bone. A specific pattern of bone mineralization is seen with respect to person's age and gender right from birth to adulthood. A few researchers proved that after the age of 30, there will be a steady and natural loss of bone mass as the age progresses. However, the bone mineralization maintenance is determined by hereditary factors, nutritional status, body mass and hormonal environment. The present study includes the measurement of bone density of female individuals by DEXA scan. The sample size includes 122 females from Sulaymaniyah of Kurdistan region, Iraq.

The bone density is determined and compared with the T-score to check the prevalence of osteoporosis and osteopenia. Thus, obtained results are statistically analyzed by using SPSS software and age-wise distribution and trend of osteopenia and osteoporosis is obtained. The present investigation showed that as age progresses the risk for osteopenia and osteoporosis increases. The incidence of osteopenia and osteoporosis has risen significantly in the females with menopause. It is evidenced from the results that the women with the age below 40 are presented with osteopenia and the women above the age of 40 with osteoporosis. The maximum number of women presented with both osteoporosis and osteopenia is seen in age group ranging from 60-70 years of age. This investigation helps the medical team to focus on therapeutic management and lifestyle changes to be followed to lessen the chances of loss of bone mass. The recommendations include correction of calcium and vitamin D deficiency, cessation of smoking and alcohol consumption, consumption of balanced diet that include dairy products and exposure to sunlight.

Keywords: Osteoporosis, Osteopenia, DEXA scan, Bone Density, T-score, Menopause

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1. Introduction

Osteopenia is a clinical term that refers to the condition of decreased bone mineral density (BMD) when compared to normal reference values. Decrease in BMD values reflect the underlying damage occurring in the microarchitecture of the bone [1].

1.1.Etiology

A known pattern of bone mineralization which is specific to an individual's age and sex is seen right from the stage of birth to adulthood. When an individual reaches puberty, the bone mineral accretion escalates to its maximum level. Males usually reach 95% of adult bone mass by age 21 and females typically reach this milestone at age 17. Hence, by the third decade of life, one has reached peak bone mass. Early signs of decreased bone mass that result from not reaching peak bone mass as a young adult raise the risk of fragility fractures even in adolescence and early adulthood [Condition called Osteopenia or Osteoporosis].

A gradual and natural loss of bone mass occurs after the age of 30 over the following decades and into later life.[2].

Weight-bearing exercises, nutritional status (getting enough calcium and vitamin D daily), body mass, and hormonal environment are modifiable factors that affect how quickly bones naturally lose mass as we age. It is thought that up to 80% of our ability to reach and maintain optimal bone mineralization levels is determined by hereditary factors. [3].

It is believed that the basic forms of osteopenia and osteoporosis are brought on by the normal, gradual bone loss that occurs in adults. This process is accelerated by secondary factors like alcohol dependence, smoking, low levels of physical activity, and slim body habitus (Body fat percentage under 18.5 kg/m2). Anorexia, bulimia, Cushing's syndrome, hyperparathyroidism, hyperthyroidism, inflammatory diseases like lupus or Crohn's disease, malabsorption syndromes, persistent kidney failure, amenorrhea/oligomenorrhea, early onset menopause, and chronic illnesses are among the risk factors for osteopenia. Because of the calcium and/or vitamin D deficits caused by these illnesses, patients may need to take long-term doses of glucocorticoids or steroids, proton pump inhibitors, valproic acid, antiepileptic drugs, and chemotherapy.

1.2.Pathophysiology

Resorption, or the daily waste of minute amounts of bone mineral, is compensated by deposition of new material in order to maintain bone strength in adulthood. The bones continue to degrade and may eventually become brittle and fracture-prone if this equilibrium tilts too far in favor of resorption (osteoporosis).

This continual bone remodeling, also known as bone resorption and deposition, is directly tied to the pathophysiology of osteoporosis. By comprehending how bone remodeling is managed, osteoporosis can be effectively avoided and treated.

The ratio of bone resorption to bone deposition is regulated by the activity of two important cell types, osteoclasts and osteoblasts, which have different ancestries. Extremely active ion channels

are present in the cell membrane of osteoclasts, which pump protons into the extracellular space to lower the pH in their own microenvironment.

The pH decrease causes the bone mineral to disintegrate. In this milieu, they also produce proteolytic enzymes like cathepsin K, which break down bone matrix. Osteoblasts create new bone by a process that is still poorly understood. The interaction between these two cell types of controls whether bone is created, maintained, or lost. Additionally, there is a close connection between the functions of these cells [4].

In a typical bone remodeling cycle, osteoclasts are initially activated, leading to bone resorption. Bone production begins as successive waves of osteoblasts create and lay down new bone matrix after a brief "reversal" phase during which osteoblast precursors inhabit the resorption "pit." [5].

Since the bone production phase often lasts substantially longer than the resorption phase, any increase in remodeling activity frequently results in a net loss of bone. At different stages of this process, the precursors, osteoclasts, and osteoblasts communicate with one another by producing various "signaling" molecules [6].

1.3.Modulators of bone formation:

Hormones are arguably the most significant regulators of bone growth. It is well recognized that testosterone, parathyroid hormone, and estrogen are crucial for bone growth and maintenance [7].

The effects of these hormones on bone remodeling depend on how they alter osteoclast and/or osteoblast activity. Specific cell surface receptors help carry signals from external bone cells into the cell nucleus to turn on or off various genes that regulate cell activity. These include the BMP family protein receptors, which are potent bone growth inducers.

Estrogen is now believed to have the most direct effect on bone cells through interacting with certain proteins, or receptors, on the surfaces of osteoblasts and osteoclasts [8].

The uterus and breasts are just two tissues that are significantly impacted by estrogen, which is naturally produced and delivered into the bloodstream some distance from the bone. Other locally produced signaling molecules, however, have a considerable impact on bone physiology.

Osteoclast precursor cells differentiate into fully differentiated osteoclasts as a result of the cognate partner RANK ligand (RANKL) activating the cell surface receptor known as RANK (receptor activator of NF kB) [9].

In actuality, the signaling molecule RANKL, which is produced by osteoblasts, is one of many that encourage interaction between osteoblasts and osteoclasts and help to coordinate bone remodeling. In order to keep RANK and RANKL apart, osteoprotegerin, a distinct protein released by osteoblasts, can bind to RANKL. The RANKL/osteoprotegerin ratio may affect the risk of osteoporosis.

Thus, the inhibitors of RANKL are known to have a promising role in the treatment of osteoporosis.

1.4.The impact of genetical factors:

For a variety of causes, including tiny changes in the genetic code, a person's osteoblasts or osteoclasts may be more active or receptive to their surroundings. These differences might also show regulatory systems that were not known before. Environmental variables can also have a substantial impact on bone physiology.

2. Evaluation of osteopenia among women of Sulaymaniyah, Kurdistan Region:

2.1.Subject Selection:

The evaluation study is conducted from July 2021 to November 2022 at the department of radiology, Anwar Sheikha Medical City, As Sulaymaniyah, Iraq which included females over 20 years of age. A standardized proforma, including age, weight, height, and dietary history about calcium and vitamin D, was filled by the subjects which can be considered as consent from the individuals for conducting the study.

2.2.Methods

The diagnostic technique used to diagnose bone mineral density (BMD) is Dual Energy X-Ray Absorptiometry (DEXA) and the bone density densitometer used is Osteosys.

The bone mineral density test (bone density test) is used to measure the bone mineral content and density. The techniques include X-rays, dual-energy X-ray absorptiometry (DEXA or DXA), or a special CT scan. DEXA is referred to as the gold standard method to assess BMD. The routinely evaluated sites include lumbar (L_1-L_4), femoral neck and wrist.

The T score is used to express the BMD results. According to WHO diagnostic guidelines, osteoporosis is defined as having a T score of less than or equal to -2.5, osteopenia as having a T score between -2.5 and -1, and normal is defined as having a T score of more than or equal to -1.

2.2.1. DEXA

The DXA scan is used to assess the spine's and the hip's bone mineral density which helps in determining the risk of osteoporosis in the individuals. The advantages of examinations include prediction of fracture risk, targeting anti-fracture therapy and monitoring the response to the treatment. In order to establish the new WHO algorithm for treating patients based on their unique fracture risk, the current observational study is focused on the clinical features of DXA screening. Thus, the treatment can be personalized based on the DXA examination of the patients for effective treatment outcome.

BMD assessments are now crucial for identifying people at risk for osteoporosis and determining how best to employ anti-fracture therapy.[10,11,12]

DXA scans of the central skeleton are typically the primary testing method for determining the BMD of the hip and lumbar spine. The three primary goals of central DXA tests are to identify osteoporosis, assess a patient's risk of fracture, and track the effectiveness of treatment.

The most accurate measurement for determining the risk of hip fracture is hip BMD and, which is one of the reasons why using central DXA is preferred. [13,14,15]. The spine BMD assessment is considered in monitoring the treatment. [16,17]

The WHO T-score definitions of osteoporosis and osteopenia, which are provided in table no.1, are used to interpret the spine and hip BMD evaluations of postmenopausal white women.

Table No.1 Interpretation of T-score

Terminology	**T-score definition**
Normal	$T \geq -1.0$
Osteopenia	$-2.5 < T < -1.0$
Osteoporosis	$T \leq -2.5$
Established osteoporosis	$T \leq -2.5$ in the presence of one or more fragility fractures.

An individual's BMD is compared to healthy young adults (T-score) and adults of similar age (Z-score). The candidate's BMD result is contrasted with healthy persons between the ages of 25 and 35 who are of the same sex and ethnicity.

The variation between the candidate's BMD and that of young people in good health is known as the standard deviation (SD) which results in T-score. The stronger bones are those with positive T-scores compared to those with negative T-scores.

As per the World Health Organization, osteoporosis is described based on bone density levels as follows:

i. Normal bone density is indicated by a T-score that is within 1 SD (+1 or -1) of the young adult mean.
ii. Low bone mass is indicated by a T-score of 1 to 2.5 SD (-1 to -2.5 SD) below the young adult mean.
iii. Osteoporosis is present when the T-score is 2.5 SD or more (greater than -2.5 SD) below the young adult mean.

With each SD below normal, the likelihood of a bone fracture often doubles. Therefore, someone with a BMD that is 1 SD below average (T-score of -1) is twice as likely to suffer a bone fracture as someone with a normal BMD. Individuals who are at a high risk for bone fracture will receive focused treatment once this information is available to prevent subsequent fractures. When bone density is more than 2.5 SD below average for young adults and there have been one or more past fractures due to osteoporosis, it is said to be severe (established) osteoporosis.

The candidate's BMD is compared to the Z-score, an age-appropriate benchmark, in the second comparison. Z-scores are calculated similarly, but comparisons are made to individuals who share your age, sex, race, height, and weight. The bone density test can be used to accurately diagnose osteoporosis and estimate the rate of bone loss, which will increase the clinical effectiveness of the treatment. [18]

2.2.2. Other diagnostic recommendations

Blood tests, for example, can be used to diagnose renal disease, evaluate parathyroid gland function, evaluate the results of corticosteroid medication, and/or measure levels of minerals in the body connected to bone strength, such calcium. These other diagnostic tests also include bone densitometry testing.

Since there are many risk factors for osteoporosis, such as age, smoking, low body mass index, excessive alcohol consumption, family history of hip fractures, long-term steroid use, chronic illnesses like rheumatoid arthritis, liver disease, kidney disease, diabetes mellitus type 1, hyperthyroidism, and/or hyperparathyroidism, other diagnostic tools play a significant role in determining the stages of bone loss.

3. Results

Statistical analysis:

Observational study is conducted on a sample size of 122 females. Thus, the data is organized and presented systematically using SPSS. Frequency distribution table is used for the creating. different class intervals. The one-way Frequency distribution table is then presented graphically using Bar graph.

The observed bone mineral density of females of age ranging from 20 and above is given in table no. 02, figure no.01 and the T-scores are shown in figure no.02.

Table No.02 Age wise prevalence of osteopenia and osteoporosis

Age-wise distribution and trend of osteopenia & osteoporosis					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Normal	30	24.6	24.6	24.6
	Osteopenia	70	57.4	57.4	82.0
	Osteoporosis	22	18.0	18.0	100.0
	Total	122	100.0	100.0	

Figure No.01 Prevalence of osteopenia and osteoporosis

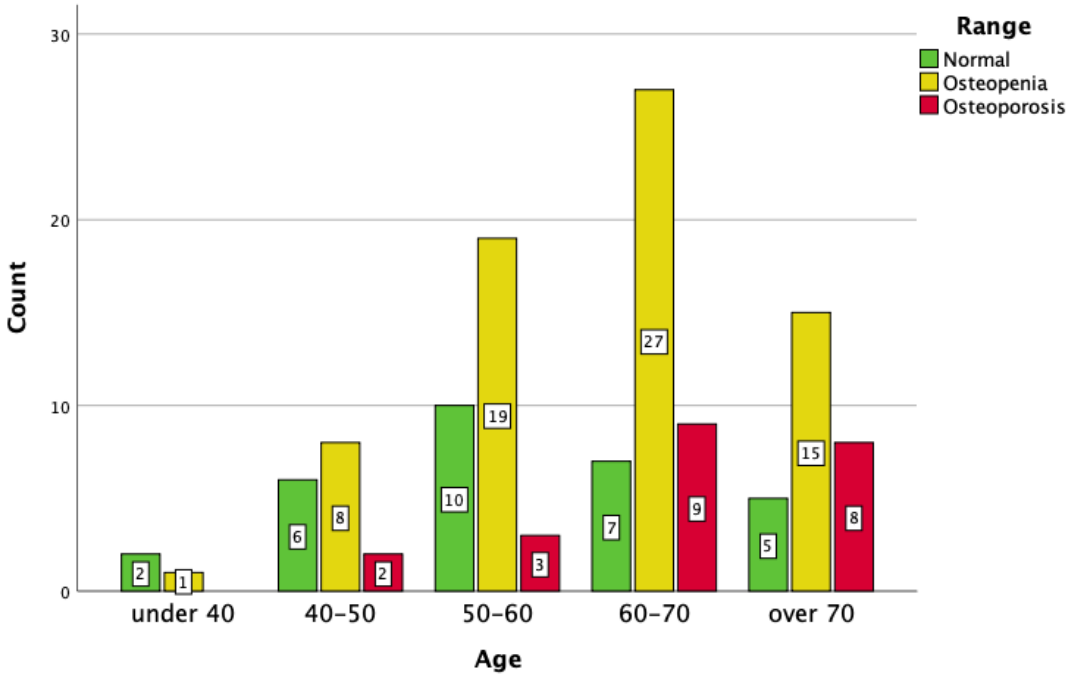
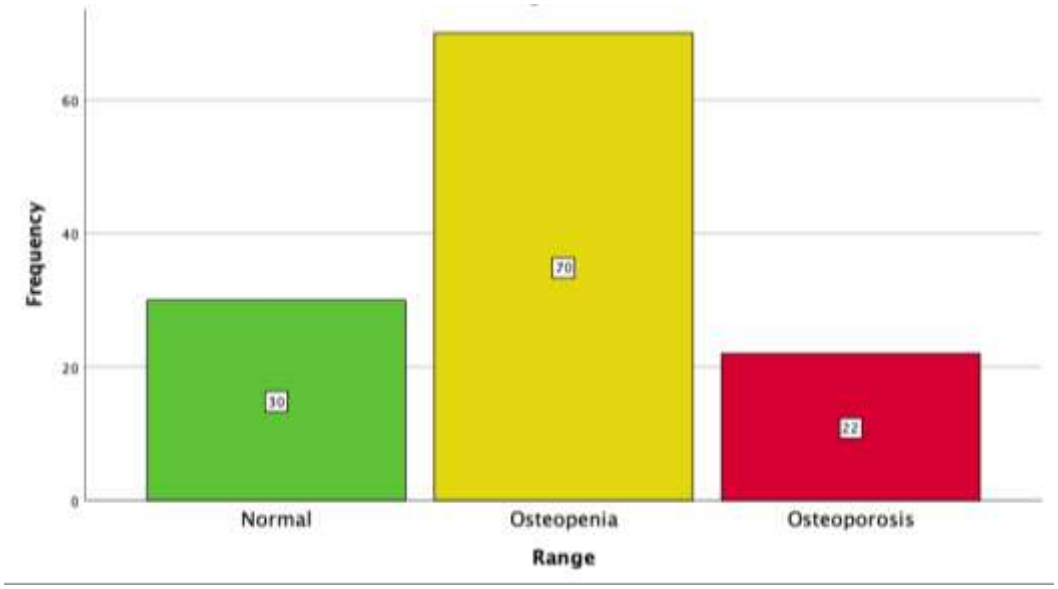


Figure No.02 Bone mineral density and T scores of patients with osteoporosis and osteopenia



In the present study, 122 females are included, out of which 57.4% are found to have osteopenia and 18% are found to have osteoporosis. From this observational study, it is found that as the age progresses the risk for osteopenia and osteoporosis increases. In women going through menopause, the prevalence of osteopenia and osteoporosis has considerably increased.

The subjects are categorized into five groups. In the first group, below 40 years of age, out of 3 women, one is found to have osteopenia. In the second group (40-50 years of age), out of 16 women, 8 have osteopenia and 2 are found to have osteoporosis. In the third group (50-60 years of age), out of 32 women, osteopenia is seen in 19 and osteoporosis is seen in 3 women. In the fourth group (60-70 years of age), out of 43 women, 27 are found to have osteopenia and 9 women have osteoporosis.

In the last group (above 70 years of age), out of 26 women, 15 women are found to have osteopenia and 8 women have osteoporosis. The age wise prevalence is shown in figure no.01.

Thus, from the results it is observed that the women with age below 40 had osteopenia and women with age above 40 have osteoporosis. The incidence of osteoporosis is 18% and osteopenia is 57.4%. The maximum number of women presented with both osteoporosis and osteopenia is seen in age group ranging from 60-70 years of age.

Osteopenia and osteoporosis are more prevalent after the age of 70, showing that they are age- and postmenopausal-related conditions. This shows that the increased trend in incidence may be due to a decline in estrogenic activity.

4. Discussion

Women should be screened after age of 65, according to the International Osteoporosis Foundation. However, due to their altered lifestyles (dieting, smoking, and inactivity) and sun exposure, young people are now more susceptible to osteoporosis. There is also a higher occurrence of additional risk factors, such as low socioeconomic strata, low calcium intake, vitamin D deficiency, low education level, premature menopause, multiparity, and prolonged lactation, all of which put women at a higher risk for osteopenia and osteoporosis.

Using the WHO T-score criteria and the calcaneal QUS technique, screening for osteopenia and osteoporosis in a Sulaymaniyah community revealed a prevalence of osteopenia and osteoporosis in 122 women. In the current investigation, age affected the results of osteopenia and osteoporosis scores. If their BMD is low, the patients in the current study are instructed to have a Dual-energy X-ray absorptiometry (DEXA) scan to confirm the diagnosis. The United States Preventive Services Task Force recommends routine osteoporosis screening for women over the age of 65 [19].

We need to conduct additional research in Sulaymaniyah to determine whether screening at an earlier age and research on osteoporosis in women are necessary. Osteopenia is already prevalent in women, as observed in this study, therefore measuring BMD will aid in an early diagnosis. Early diagnostic intervention in these women will allow for therapy such as vitamin d and

Calcium supplementation, as well as the use of anti - resorptive medicines, decreasing morbidity and risk of death associated with osteoporosis.

4.1.Therapeutic recommendations

Increases in hip and spine bone density are frequently achieved with weekly walking of 3 to 5 miles, vitamin D and calcium supplementation, and nutritional restoration. Numerous pharmaceutical treatments, such as anti-resorptive therapy, selective estrogen receptor modulator therapy, and hormone replacement therapy, have been suggested for the treatment of osteopenia and osteoporosis. Similarly, anabolic therapy can significantly increase bone density in patients with osteoporosis who have seen failure with anti-resorptive medication [3].

4.2. Lifestyle Recommendation

Smoking and alcohol use over an extended period lower bone mineral density. Therefore, patients should receive counseling on quitting drinking and smoking as well as frequent exercise increasing activity, encourage healthy diet, diary product and sun exposure.

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