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Exploring the Link between Vitamin D Levels and Bone Health: Insights into Osteopenia and Osteoporosis Among Postmenopausal Women in Basrah, Iraq

Mustafa Abd Almajeed Hussein[1], Nawal Khalil Ibrahim[2]
[1,2] Department of Physiology, College of Medicine, University of Basrah, Basrah, Iraq
https://orcid.org/0000-0002-1459-9291

Email: abdalmajeed46@yahoo.com1, mustafa.hussein@uobasrah.edu.iq[2]

Abstract. Although vitamin D is essential for bone metabolism, postmenopausal women frequently experience vitamin D insufficiency and shortage, which may have an impact on microarchticher, and bone mineral density (BMD). However, the results of previous research are inconsistent, and need more investigation for advanced research of extensive studies that are now available. Methods: 260 postmenopausal women age between (55-75) years old who were diagnosed with osteopenia and osteoporosis were included in this investigation. The parameter were gauged include serum 25,(OH) D level. Dual-energy X-ray absorptiometry (DXA) was used to diagnose BMD in all locations, including the lumbar spine, femoral neck, and whole hip. Using a generic linear model with body mass index and age adjustments, the relationships between serum 25,(OH) D levels and BMDs were examined. Results: There were significant differences of serum 25,(OH) D for the osteopenia group and also for the osteoporosis group in every patient that was part in this study. 25,(OH) D low levels were positively correlated with both pelvic and femur neck BMD in the osteoporosis group. Additionally, to the osteopenia cohort group, deficiency vitamin D scales were linked in neck femur and total hip BMD. The same patterns were noted in patients with osteoporosis ($p < 0.05$) and decrease levels of 25,(OH) D in those with lumbar spine BMD. Conclusions: Postmenopausal women with osteopenia and osteoporosis had a significant frequency of vitamin D deficiency and insufficiency, according to this study, which also examined the connections between vitamin D and BMD; the findings advance a more thorough comprehension of the potential effects of vitamin D on bone health.

Highlights:

1. Assess vitamin D's impact on BMD in postmenopausal women.
2. Analyzed 260 women using serum 25(OH)D and DXA measurements.
3. Vitamin D deficiency linked to lower BMD in spine and hip..

Keywords: Vitamin D, Osteoporosis, Osteopenia, Postmenopausal Women

Introduction

By enhancing intestinal calcium absorption, a fat-soluble vitamin D, is necessary for bone metabolism, lowers the incidence of osteomalacia in adults and rickets in children [1]. The body typically absorbs vitamin D, which includes vitamin D2 and vitamin D3, by diet or exposure to sunlight. Then, in the liver, vitamin D-25-hydroxylase

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mechanism action change vitamin D into 25-hydroxyvitamin D [25,(OH) D], and in the kidneys, the enzyme 25,hydroxyvitamin D-1α,hydroxylase transforms 25,(OH)D into its active form, 1,25-dihydroxyvitamin D [1,25,(OH)2D] [2]. Because of its lengthy half-life in the bloodstream, serum 25(OH)D is now regarded as the most accurate indicator of vitamin D status [3]. Postmenopausal women experience substantial bone loss due to estrogen insufficiency. They are also highly susceptible to vitamin D insufficiency [4]. In a study of different countries 7441 postmenopausal women with osteoporosis, scientist discovered that the expansion of 25,(OH) D was decreased in old people according some relation with physiological parameters like estrogen deficiency and bone turnover factors related with vit D [5]. The impact of 25,(OH) D on postmenopausal women's bone mineral density (BMD) has been the subject of several recent researches; however the findings are debatable [6]. According to several descriptive investigations, 25,(OH) D was invariably connected at various locations, including BMD of the lumbar spine and femur neck and pelvic [7,8].

Nevertheless, some research indicates that 25(OH) D and BMD are unrelated; the majority of research on supplementation vitamin D to postmenopausal women has not shown any success in raising BMD in randomized controlled trials [9]. For instance, some researchers found no discernible difference in BMD between the supplementation group of calcium + vitamin D2 and complement group of calcium at any site [10]. However, others found that while there was no divergence in BMD area as determined by dual-energy X-ray absorptiometry (DEXA), the vitamin D3 supplementation group had significantly higher volumetric BMD in the femur neck and trochanter regions [11]. A significant numeral women have osteopenia, or middle lowest BMD ($-2.5 < \text{T-score} < -1.0$), matched to osteoporosis, but many studies have been limited by little model sizes and only converge on postmenopausal females with osteoporosis, or severely subdued BMD ($\text{T-score} \leq -2.5$) [12]. The assembly between 25,(OH) D, and BMD in postmenopausal females with osteopenia and osteoporosis must thus be investigated in large-scale investigations, for the purpose of creating the best therapies, this better understanding is essential [13]. These disparate findings highlight the crucial need for additional research and the intricate role that 25,(OH) D plays a plinth in metabolism bone. Making use of a real data from high-quality electronic health record (EHR) is a more beneficial strategy for this specific research issue [14].

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Consequently, the purpose of this study is to characterize the vitamin D status of postmenopausal women in Basrah, Iraq who have osteopenia and osteoporosis, and to look into the connection between 25,(OH) D and BMD, in this paradigm.

Methods

Patients:

From March to September 2024, we included 260 women patients average age between (55-75) years old who were not on anti-osteoporotic medication and who had been diagnosed with osteopenia and osteoporosis at their initial visit in al zahraa center for measure bone mineral density in Ibn Albitar Private Hospital of Basrtah. At the first inpatient visit, medical information was gathered, including BMD, demographic, anthropometric beside laboratory and diagnostic features for exclusion chronic disease in case study. The following were the study's inclusion requirements: be older than 55 and have experienced menopause, which was defined as not having a period for at least a year , osteopenia a DEXA gauged bone mineral density (BMD) was $-2.5 < T$ score < -1.0 , osteoporosis T score ≤ -2.5 or had a hip or vertebral subtlety fracture, or proximal humerus fracture , distal forearm or pelvic with osteopenia , not swallow any medication of anti-osteoporotic, and not taking vitamin D or any supplementation in the previous six months. In this study, patients who satisfied any of the following requirements were not allowed to participate: have a non-weak fracture during the last 12 months, secondary osteoporosis, cancer, renal problems, osteomalacia, hyperthyroidism, hyperparathyroidism and women who are not yet menopausal [15]. Following an overnight fast, patients' blood samples were taken to check their serum levels of 25,(OH) D. following the manufacturer instructions (Roche Diagnostic) automated electrochemiluminescence system was used to obtain the aforementioned biochemical measurements. A DEXA (GE, Lunar Prodigy, USA) was used to quantify the BMD of the pelvic, femur neck and spine (L1-L4) [16]. BMD rating at fracture were not included for patients with lumbar spine fractures. All patients had their BMDs measured by qualified technicians.

Demographic and clinical characteristics:

260 postmenopausal women were enrolled in this study. Of them, 143 individuals were found to have osteoporosis, while 117 individuals were found to have

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osteopenia. Age, height, weight, BMI, and BMD all showed significant statistical differences between the two groups ($p < 0.05$). The group of osteoporosis patients fixed to be older and to have lowered 25(OH) D levels, BMI, and BMD at all locations of measurement. The split of patients depends on their serum 25,(OH) D levels into: deficiency (less than 20 ng/mL), insufficiency (between 20and 30 ng/mL), and sufficiency (more than 30 ng/mL).

Statistical Analysis:

Statistical augury was resolved at a sill of $p < 0.05$. All statistical dissection were completed by use a p values in SPSS program, ANOVA (version 24) to calculate the three groups of median rate using chi-square test for categorical parameters

Result and Discussion

Table 1 displays the subject characteristics of these groups. The majority of patients had low levels of 25(OH) D. Statistical significant show no differences between the three groups in age, weight, BMI, and BMD except in cases with varying 25,(OH)D levels showed statistically significant differences with osteoporosis (T-score) at all sites of groups division ($p < 0.05$).

Table 1:- Lists the subjects' baseline anthropometric traits based on their various 25(OH) D levels.

Parameters	**All (n= 260)**	**Sufficiency≥ 30 n= 26**	**Insufficiency 20-30 n= 71**	**Deficiency< 20 n= 163**
Age (years)	63.85± 8.75	64.61± 8.11	63.72± 8.96	63.22± 8.53
Weight (kg)	68.47± 4.64	67.16± 4.39	69.93± 4.82	68.34± 4.41
Height (cm)	159.98± 7.32	160.26± 7.74	159.13± 7.79	160.56± 7.98
BMI (Kg/m^2)	26.1± 5.43	25.38± 5.79	26.13± 5.99	26.81± 5.22
Total Hip BMD (g/cm^2)	0.87± 1.55	0.86± 1.59	0.86± 1.59	0.89± 2.49
Femur neck BMD (g/cm2)	0.77± 2.30	0.77± 2.30	0.79± 2.66	0.75± 1.82
Lumber spine L1-L4 BMD (g/cm2)	0.96± 3.13	0.95± 2.98	0.96± 3.32	0.99± 3.52
Osteoporosis (T- score)	-2.5± 1.44	-1.9± 3.66*	-2.1± 1.81*	-3.7± 2.58*
25(OH) D levels (ng/ml)	28.42± 3.33	42.63± 4.88 *	29.92± 5.63	12.72± 7.64 *

* Significant differences as mean ($p < 0.05$)

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Comparing vitamin D insufficiency to the two groups prior to it, table 2 link between vitamin D levels within the osteoporosis and osteopenia categories revealed a substantial relevance.

Table 2:- 25,(OH) D level distribution in postmenopausal women with osteopenia and osteoporosis.

All (n= 260)	**Osteopenia (n= 117)**	**Osteoporosis (n= 143)**
25(OH)D (ng/mL)	19.36±5.91	14.87± 6.63
Sufficiency (≥30ng/mL)	23 (19.65%)	29 (20.27%)
Insufficiency (20–30ng/mL)	35 (29.91%)	41 (28.67%)
Deficiency (<20ng/mL)	59 (50.42%)*	73 (51.04%)*

* Deficiency 25-hydroxy vitamin D, are presented a significant values in ($p<0.05$).

The distribution of postmenopausal women by age group and their correlation with vitamin D is displayed in table 3. At the probability level ($p<0.05$) the findings indicated a positive and substantial correlation between the three groups and the age-related vitamin D level.

Table 3:- Distribution of postmenopausal women's 25(OH) D levels by age.

Age(years)	**Numbers**	**25,(OH) D ng/mL**	**Sufficiency (≥30ng/mL)**	**Insufficiency (20–30ng/mL)**	**Deficiency (<20ng/mL)**
55-59	49	18.51± 2.66	11(22.44%)	15(30.61%)*	23(46.93%)*
60-69	119	14. 84± 2.31*	16(13.44%)	36(30.25%)*	67(56.3%)*
70-75	92	12. 75± 2.28*	10(10.86%)	29(31.52%)*	53(57.6%)*
P value		<0.05	<0.05	<0.05	<0.05

* There are significant values ($p<0.05$) for 25-hydroxy vitamin D among age categories study.

In this actual study, we found that among patients with osteopenia and osteoporosis, blood 25,(OH) D levels and BMD were positively correlated. In Iraq, especially in Basrah, our research offers thorough understanding of these disorders in

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people with osteopenia and osteoporosis, increasing knowledge of the critical function that vitamin D plays in these disorders. As seen in Tables 2 and 3, our study, which included 260 postmenopausal women, provided a thorough account of the distribution of vitamin D in osteopenia, osteoporosis, and various age groups, the relevance between bones and vitamin D is linked to metabolic processes within the fine structures responsible for providing hardness and maintaining bone strength from a physiological perspective due to its role in metabolism and the dynamics of bone turnover factors in building fine particles [17,18]. Also it considered the beginning of the formation and concentration of strength standards that support molecular and permanent cohesion as an essential and pivotal part for consolidating the link between vitamin D and calcium in women, especially after menopause [19]. Collectively, these results support earlier studies that highlight the high frequency of vitamin D deficiency and insufficiency in the community as well as the pervasive problem of hypo vitamin D levels [20]. In postmenopausal women the connection by BMD and vitamin D has been the subject of numerous investigations, some studies, for instance, have indicated a beneficial relationship by BMD and vitamin D at various sites [21]. However, other studies have found no meaningful correlation between vitamin D and BMD; these studies may have included fewer patients and did not classify women based on BMD, which could explain the discrepancy in the results [22]. To classify the patients based on their BMD into two groups: osteopenia and osteoporosis following age and BMI adjustments, we ultimately concluded that low vitamin D levels were linked to higher BMD at all sites for patients with osteoporosis while lower levels of vitamin D was linked to lower neck femur BMD and pelvic for patients with osteopenia [23]. The relatively low correlation coefficients in this search and other surveys that found an affirmative links between BMD and hypo-vitamin, however, suggest that it is challenging to significantly raise bone density in postmenopausal women by taking vitamin D supplements [24]. Keep up enough amount of vitamin D in postmenopausal women may be intended to preserve preexisting the mass of bone or to postpone the eventual loss of bone hardness, because a lack of estrogen lead to deficiency in bone turnover [25]. In postmenopausal women with vitamin D deficiency or insufficiency, appropriate vitamin D administration may help to maintain a low level that may help minimize bone loss; the recommended supplementation for patients with vitamin D insufficiency differs by area [26,27]. In order

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to encourage research on postmenopausal women with osteopenia, we classified the postmenopausal women according to their bone density variables and concentrated on patients who had osteopenia and osteoporosis

Conclusion

In summary, this study found that postmenopausal women in Basrah who had osteopenia and osteoporosis had a significant frequency of vitamin D deficiency and insufficiency. A more thorough knowledge of how vitamin D can affect bone health may result from the connections shown between vitamin D and BMD

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Ethics Statment

We obtained approval from the patients that participant in this research according to ethics approval and consent to participate

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Conflist of Interst

The study was carried out without any financial or commercial ties that might be seen as a potential conflict of interest, according to the authors

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