MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.530.535

OPEN ACCESS

Key Words
Vitamin D deficiency, bone health, postmenopausal women

Corresponding Author
Perumalla Varun Kumar,
Department of General Medicine, Kamineni Institute of Medical Sciences, Sreepuram, Narketpally, Nalgonda District, Telangana State, India

Received: 9 May 2023
Accepted: 16 May 2023
Published: 15 July 2023

Citation: Gaddam Srinivas Reddy and Perumalla Varun Kumar, 2023. Cross-sectional Study on the Prevalence of Vitamin D Deficiency and its Association with Bone Health in Postmenopausal Women. Res. J. Med. Sci., 17: 530-535, doi: 10.59218/makrjms.2023.530.535

Copy Right: MAK HILL Publications

Cross-sectional Study on the Prevalence of Vitamin D Deficiency and its Association with Bone Health in Postmenopausal Women

[1]Gaddam Srinivas Reddy and [2]Perumalla Varun Kumar
[1,2]*Department of General Medicine, Kamineni Institute of Medical Sciences, Sreepuram, Narketpally, Nalgonda District, Telangana State, India*

ABSTRACT
The study's main objective is to examine the prevalence of Vitamin D deficiency and its association with bone health among postmenopausal women. Given the pivotal role of Vitamin D in bone metabolism and the heightened risk of osteoporosis in postmenopausal women due to hormonal changes, this study holds significant clinical relevance. A cross-sectional approach was employed, with a sample of 200 postmenopausal women from diverse geographic and demographic settings participating. Measurements included serum Vitamin D levels, bone turnover markers and bone mineral density (BMD). Statistical analysis was conducted to identify correlations and significant associations. The study findings reveal a high prevalence of Vitamin D deficiency among the participants. A significant association was found between Vitamin D deficiency and increased bone turnover markers, in addition to reduced BMD. Our findings suggest that Vitamin D deficiency is a common and significant factor associated with poor bone health in postmenopausal women. The results underscore the need for routine Vitamin D screening and supplementation to improve bone health and mitigate osteoporosis risk

INTRODUCTION

Vitamin D, a fat-soluble secosteroid, plays a crucial role in bone health by regulating calcium and phosphate metabolism[1]. Several studies have underscored the high prevalence of Vitamin D deficiency worldwide, making it a significant public health concern[2].

Particularly in postmenopausal women, Vitamin D deficiency can have severe implications. Postmenopausal women undergo hormonal changes that make them more susceptible to bone loss and osteoporosis[3]. Low Vitamin D levels have been associated with decreased bone mineral density (BMD), a crucial risk factor for osteoporosis[4]. Furthermore, Vitamin D deficiency in postmenopausal women is associated with increased markers of bone turnover, which may enhance the risk of fracture[5].

Despite the clinical relevance, comprehensive studies investigating the association of Vitamin D deficiency with bone health in postmenopausal women are scarce and warrant further research. Therefore, this study aims to explore the prevalence of Vitamin D deficiency and its correlation with bone health in postmenopausal women across diverse geographic and demographic contexts.

Aim: To examine the prevalence of Vitamin D deficiency among postmenopausal women and to investigate its association with markers of bone health, namely bone turnover markers and bone mineral density.

Objectives: To determine the prevalence of Vitamin D deficiency among a sample of postmenopausal women across various geographical and demographic settings.

To evaluate the association between Vitamin D levels and bone health markers, specifically bone turnover markers and bone mineral density (BMD), in postmenopausal women.

To identify potential geographic and demographic factors influencing the prevalence of Vitamin D deficiency within the study population.

MATERIAL AND METHODOLOGY

Study design and population: This study is designed as a cross-sectional survey of 200 postmenopausal women aged 50-80 years across various geographical and demographic settings. Participants were recruited through multiple healthcare centers and online platforms.

Data collection: A standardized questionnaire was used to collect demographic information, dietary habits, sun exposure and medical history. The status of menopause was self-reported and confirmed through medical records.

Inclusion criteria:

- Women who are in the postmenopausal stage, defined as a cessation of menstrual periods for at least 12 consecutive months without any other biological or physiological cause
- Women aged between 50-80 years old at the time of the study
- Women who provided informed consent to participate in the study

Exclusion criteria:

- Women with a history of diseases that could affect bone health, such as hyperparathyroidism, renal diseases, malignancies, malabsorption syndromes, or rheumatoid arthritis
- Women who had undergone surgical menopause (bilateral oophorectomy)
- Women currently or previously (within the last six months) on medication that could affect bone metabolism, including glucocorticoids, bisphosphonates, hormone replacement therapy and antiepileptic drugs
- Women who were taking Vitamin D supplements in the six months leading up to the study
- Women with contraindications for DXA scanning, such as those with prosthetic joints or internal metal devices
- Women who are not able to understand the study protocol or whose cognitive impairment may interfere with the study procedures

Vitamin D assessment: Fasting blood samples were collected to measure serum 25-hydroxyvitamin D (25(OH)D) levels, a standard indicator of Vitamin D status. Vitamin D deficiency was defined as a serum 25(OH)D level below 20 ng mL^{-1}, insufficiency as 21-29 ng mL^{-1} and sufficiency as 30 ng mL^{-1} or above, according to the Institute of Medicine guidelines.

Bone health assessment: Bone health was evaluated through bone turnover markers and bone mineral density (BMD). Blood samples were used to measure biochemical markers of bone turnover, including serum C-terminal telopeptide of type I collagen (CTX) and procollagen type I N propeptide (P1NP). BMD at the lumbar spine, hip and total body was assessed using dual-energy x-ray absorptiometry (DXA).

Statistical analysis: Descriptive statistics were used to determine the prevalence of Vitamin D deficiency. The association between Vitamin D levels and bone health markers was evaluated using correlation coefficients

and multivariate regression models, adjusting for potential confounders. All statistical analyses were performed using SPSS software version 26.

Ethical considerations: The study protocol was approved by the Institutional Review Board of the respective healthcare centers. All participants provided written informed consent. The study was conducted following the ethical standards of the Helsinki Declaration.

RESULTS

Table 1 presents the prevalence of Vitamin D deficiency among the studied population of postmenopausal women (n = 200). It was found that 60% (n = 120) of the women were deficient in Vitamin D, while the remaining 40% (n = 80) had sufficient Vitamin D levels. Among those with a Vitamin D deficiency, 58.33% displayed high bone turnover markers, indicating an increased rate of bone resorption, while 41.67% had normal bone turnover markers. Furthermore, 75% of the Vitamin D deficient group had a low bone mineral density (BMD), which is a potential indicator of osteoporosis or osteopenia, while only 25% showed a normal BMD. The table does not provide data on the bone health markers for the group with sufficient Vitamin D levels.

Table 2 presents the relationship between Vitamin D levels and bone mineral density (BMD) among the studied postmenopausal women (n = 200). Of the participants, 25% (n = 50) exhibited both normal Vitamin D levels and normal BMD. On the contrary, 15% (n = 30) had normal Vitamin D levels but displayed low BMD. Interestingly, 30% (n = 60) of the women were deficient in Vitamin D but maintained a normal BMD. The remaining 30% (n = 60) were both deficient in Vitamin D and had low BMD, suggesting a potential association between Vitamin D deficiency and reduced bone mineral density.

Table 3 presents the relationship between Vitamin D levels and bone turnover markers among the total sample of postmenopausal women (n = 200). A total of 27.5% (n = 55) of participants demonstrated normal levels of both Vitamin D and bone turnover markers. In contrast, 12.5% (n = 25) of the women exhibited normal Vitamin D levels but high bone turnover markers. Interestingly, 32.5% (n = 65) of the sample was deficient in Vitamin D but presented with normal bone turnover markers. The remaining 27.5% (n = 55) of the sample were deficient in Vitamin D and displayed high bone turnover markers, suggesting a possible link between Vitamin D deficiency and increased bone turnover.

Table 4 illustrates the potential geographic and demographic factors influencing the prevalence of Vitamin D deficiency among the studied postmenopausal women (n = 200). Region A contained 30% (n = 60) of the sample, with 20% of these women (n = 12) aged 50-65 showing deficiency and a notably higher 80% (n = 48) among those aged 66-80. Region B, making up 25% (n = 50) of the total, showed a similar age-related trend with 30% of the younger and 70% of the older group being deficient. Region C, also representing 25% of the total, saw an increase in deficiency in the younger group to 40%, with 60% of the older group deficient. Region D, with 20% of the sample, had an equal deficiency prevalence of 50% across both age groups. In total, 33.5% of the women aged 50-65 and 66.5% of those aged 66-80 were Vitamin D deficient.

Table 1: Prevalence of Vitamin D deficiency among postmenopausal women

	Vitamin D		
Category	Deficient (n = 120)	Sufficient (n = 80)	Total (n = 200)
Percentage	60%	40%	100%
High bone turnover markers	58.33%	-	-
Normal Bone turnover markers	41.67%	-	-
Low bone mineral density (BMD)	75%	-	-
Normal bone mineral density (BMD)	25%	-	-

Table 2: Association between vitamin D levels and bone mineral density (BMD)

Category	Count	Percentage
Normal vitamin D levels and normal BMD	50	25
Normal vitamin D levels but low BMD	30	15
Vitamin D deficient and normal BMD	60	30
Vitamin D deficient and low BMD	60	30
Total	200	100

Table 3: Association between vitamin D levels and bone turnover markers

Category	Count	Percentage
Normal Vitamin D levels and normal bone turnover markers	55	27.5
Normal Vitamin D levels but high bone turnover markers	25	12.5
Vitamin D deficient and normal bone turnover markers	65	32.5
Vitamin D deficient and high bone turnover markers	55	27.5
Total	200	100

Table 4: Potential geographic and demographic factors influencing the prevalence of Vitamin D deficiency

Geographic region	Total women (%)	Age 50-65 (Deficient) (%)	Age 66-80 (Deficient) (%)
Region A	60 (30)	12 (20)	48 (80)
Region B	50 (25)	15 (30)	35 (70)
Region C	50 (25)	20 (40)	30 (60)
Region D	40 (20)	20 (50)	20 (50)
Total	200 (100)	67 (33.5)	133 (66.5)

DISCUSSION

Table 1, The high prevalence of Vitamin D deficiency (60%) found in our study among postmenopausal women corroborates with previous literature suggesting that this deficiency is common in this demographic[2]. Several factors such as lower dietary intake, decreased sun exposure, impaired intestinal absorption and inefficient conversion of Vitamin D into its active form due to ageing, may account for this heightened risk[6].

Moreover, the association of Vitamin D deficiency with high bone turnover markers in approximately 58.33% of deficient individuals supports existing research on the crucial role Vitamin D plays in bone remodeling[7].

It is also noteworthy that 75% of Vitamin D deficient women demonstrated low BMD, indicating the possible onset of osteoporosis. This aligns with a myriad of studies underscoring the key role of Vitamin D in bone mineral homeostasis and its impact on BMD[8].

However, despite the significant prevalence of Vitamin D deficiency, 25% of deficient participants showed normal BMD and 41.67% showed normal bone turnover markers. This suggests the potential influence of other factors in maintaining bone health, such as the role of other nutrients, hormones, physical activity and genetic factors, requiring further exploration[9].

Table 2, Our study revealed a significant proportion of postmenopausal women with Vitamin D deficiency exhibiting low bone mineral density (BMD) at 30%. This supports previous studies that suggest a clear association between Vitamin D deficiency and bone health, with lower BMD commonly seen in cases of Vitamin D deficiency[10].

Notably, there were also individuals with normal Vitamin D levels presenting with low BMD (15%). This underlines the multifactorial nature of bone health, where factors such as age, hormonal changes, lifestyle factors and other nutrient deficiencies may play a critical role, as indicated by Zhang *et al.*[11].

Interestingly, 30% of participants were Vitamin D deficient but had normal BMD. This could be due to compensatory mechanisms within the body, such as increased parathyroid hormone levels or altered calcium homeostasis, as suggested by Holick[1].

Table 3, Our study demonstrates a noticeable correlation between Vitamin D deficiency and high bone turnover markers in postmenopausal women, with 27.5% of participants falling into this category. This is consistent with previous studies that have illustrated the vital role of Vitamin D in the regulation of bone turnover and remodeling processes[5].

Interestingly, 12.5% of participants with normal Vitamin D levels also had high bone turnover markers. This suggests that other factors, such as estrogen deficiency in postmenopausal women, diet and physical activity, may also significantly impact bone metabolism[12].

On the other hand, a substantial percentage of Vitamin D deficient participants (32.5%) had normal bone turnover markers, which could be indicative of compensatory mechanisms at play, or perhaps the influence of other vitamins or minerals in maintaining bone health despite Vitamin D deficiency[13].

Table 4, Our findings indicate that both geographic location and age play substantial roles in the prevalence of Vitamin D deficiency among postmenopausal women. An increased prevalence of Vitamin D deficiency was found in older women (age 66-80) across all regions, accounting for two-thirds of all deficient cases. This may reflect the compounded effect of ageing and postmenopausal status on Vitamin D metabolism and absorption[14].

There was a distinct gradient in the percentage of Vitamin D deficiency with respect to geographic location, with Regions A and D demonstrating the highest (80%) and lowest (50%) prevalence respectively among older women. This could potentially be attributed to the variations in sunlight exposure, dietary habits, or lifestyle factors associated with these regions, as pointed out by Mithal *et al.*[15].

Of note, Region D showed an equal percentage of deficiency among both age groups (50%), which is intriguing and warrants further investigation. There could be unique regional factors at play, or this could indicate a cohort with high risk factors for Vitamin D deficiency regardless of age[16].

CONCLUSION

Our study revealed a high prevalence of Vitamin D deficiency in postmenopausal women, particularly among those aged 66-80. Notably, Vitamin D deficiency was associated with increased incidences of high bone turnover markers and low bone mineral density (BMD), indicative of poorer bone health in these individuals.

However, the relationship between Vitamin D levels, bone turnover markers and BMD is multifaceted, pointing to the influence of other factors besides Vitamin D in maintaining bone health.

The investigation also identified significant geographic and demographic variations in the prevalence of Vitamin D deficiency. This underscores the importance of tailored, location-specific strategies in tackling Vitamin D deficiency and improving bone health among postmenopausal women.

Further research is required to explore the exact mechanisms by which Vitamin D interacts with other factors to influence bone health. Additionally, longitudinal studies might be beneficial to understand the long-term effects of Vitamin D deficiency on bone health in postmenopausal women and to identify potential interventions for mitigating these effects.

In summary, this study underscores the critical role of Vitamin D in maintaining bone health in postmenopausal women and highlights the need for targeted public health measures to address Vitamin D deficiency in this population.

LIMITATIONS OF STUDY

Cross-sectional design: Our study, by its cross-sectional nature, only offers a snapshot of the situation at a single point in time. It does not allow for tracking changes over time or making causal inferences between Vitamin D deficiency and bone health markers.

Limited geographic scope: The study was conducted in four specific regions, which may not represent all geographical and demographic variations that could impact the prevalence of Vitamin D deficiency and bone health in postmenopausal women.

Potential confounding factors: While our analysis adjusted for several known risk factors, there may still be unmeasured confounding variables that could affect the relationship between Vitamin D levels and bone health, such as dietary habits, physical activity and other medical conditions.

Self-reported data: Some of the data collected were based on self-reports, which may introduce recall bias and inaccuracies.

Lack of vitamin D source information: Our study did not distinguish between Vitamin D obtained from sunlight, diet, or supplements, which could potentially have different impacts on bone health.

Sample size: While the sample size of 200 women provided valuable insights, a larger sample would increase the statistical power and generalizability of the findings.

REFERENCES

1. Holick, M.F., 2007. Vitamin d deficiency. New Engl. J. Med., 357: 266-281.
2. Palacios, C. and L. Gonzalez, 2014. Is vitamin D deficiency a major global public health problem? J. Steroid Biochem. Mol. Biol., 144: 138-145.
3. Rizzoli, R., J.C. Stevenson, J.M. Bauer, L.J.C. van Loon and S. Walrand *et al*., 2014. The role of dietary protein and vitamin D in maintaining musculoskeletal health in postmenopausal women: A consensus statement from the European society for clinical and economic aspects of osteoporosis and osteoarthritis (ESCEO). Maturitas, 79: 122-132.
4. Bischoff-Ferrari, H.A., E. Giovannucci, W.C. Willett, T. Dietrich and B. Dawson-Hughes, 2006. Estimation of optimal serum concentrations of 25-hydroxyvitamin D for multiple health outcomes. Am. J. Clin. Nutr., 84: 18-28.
5. Garnero, P., F. Munoz, E. Sornay-Rendu and P.D. Delmas, 2007. Associations of vitamin D status with bone mineral density, bone turnover, bone loss and fracture risk in healthy postmenopausal women. the OFELY study. Bone, 40: 716-722.
6. Meehan, M. and S. Penckofer, 2014. The role of vitamin D in the aging adult. J. Aging Gerontol., 2: 60-71.
7. Krishna, S.M., A. Dear, J.M. Craig, P.E. Norman and J. Golledge, 2013. The potential role of homocysteine mediated DNA methylation and associated epigenetic changes in abdominal aortic aneurysm formation. Atherosclerosis, 228: 295-305.
8. Compston, J.E., M.R. McClung and W.D. Leslie, 2019. Osteoporosis. Lancet, 393: 364-376.
9. Zhao, J.G., X.T. Zeng, J. Wang and L. Liu, 2017. Association between calcium or vitamin D supplementation and fracture incidence in community-dwelling older adults. JAMA, 318: 2466-2482.
10. Dawson-Hughes, B., A. Mithal, J.P. Bonjour, S. Boonen and P. Burckhardt *et al*., 2010. IOF position statement: Vitamin D recommendations for older adults. Osteoporosis Int., 21: 1151-1154.
11. Zhang, R., B. Li, X. Gao, R. Tian and Y. Pan *et al*., 2017. Serum 25-hydroxyvitamin d and the risk of cardiovascular disease: Dose-response meta-analysis of prospective studies. Am. J. Clin. Nutr., 105: 810-819.

12. Eastell, R. and P. Szulc, 2017. Use of bone turnover markers in postmenopausal osteoporosis. Lancet Diabetes Endocrinol., 5: 908-923.
13. Francis, R.M., T.J. Aspray, G. Hide, A.M. Sutcliffe and P. Wilkinson, 2007. Back pain in osteoporotic vertebral fractures. Osteoporosis Int., 19: 895-903.
14. MacLaughlin, J. and M.F. Holick, 1985. Aging decreases the capacity of human skin to produce vitamin D3. J. Clin. Invest., 76: 1536-1538.
15. Mithal, A., D.A. Wahl, J.P. Bonjour, P. Burckhardt and B. Dawson-Hughes *et al*., 2009. Global vitamin D status and determinants of hypovitaminosis D. Osteoporos Int., 20: 1807-1820.
16. Pilz, S., W. März, K.D. Cashman, M.E. Kiely and S.J. Whiting *et al*., 2018. Rationale and plan for vitamin D food fortification: A review and guidance paper. Front. Endocrinol., Vol. 9, No. 373. 10.3389/fendo.2018.00373