International Journal of Endorsing
HEALTH SCIENCE RESEARCH

IJEHSR

Original Article

Assessment of vitamin D levels in association with clinical determinants in females with hip fracture.

Muhammad Afaque Alam, Muhmmad Qasim Ali Muhammad Imran Javed, Syed Kamran Ali Shah, Zafrullah Khan & Syed Jahanzeb

Jinnah Postgraduate Medical Center, Karachi-Pakistan

Doi: 10.29052/IJEHSR.v8.i4.2020.231-237

Corresponding Author Email: maak85@gmail.com

Received 06/04/2020
Accepted 16/10/2020
First Published 01/12/2020

OPEN ACCESS

Abstract

Background: Vitamin D deficiency is associated with an increased risk of falls and hip fractures in older adults. Risk factors are suboptimal sunlight exposure and the lower cutaneous synthesis of vitamin D, reduced dietary intake of D2 (ergocalciferol) and D3 (cholecalciferol), impaired intestinal absorption, and impaired hydroxylation in the liver and kidneys. The present study's objective was to determine the frequency of vitamin D levels in females with hip fractures presenting to a tertiary care facility in Karachi, Pakistan.

Methodology: A cross-sectional study was conducted at the Orthopaedic Surgery Department of Jinnah Postgraduate Medical Center, Karachi, from 17th May to 16th November 2016. A total of 123 females with Hip fracture of ≤ 4 weeks were included in this study. Patient's age, occupation, education level, and comorbidities like diabetes mellitus (DM), hypertension (HTN), and Vitamin D levels were observed. The patient was labeled with vitamin D sufficiency, insufficiency, and deficiency on the basis of Vitamin D levels. Stratification was done, and the post-stratification Chi-square test was applied.

Results: The mean age of study participant was 60.32 ± 9.14 years and the mean duration of fracture was 12.27 ± 5.84 days, Body Mass Index (BMI) was 24.57 ± 2.77 kg/m^2, vitamin D level was 18.28 ± 8.10 ng/ml. Only 8.9% were found with sufficient vitamin D levels. Insufficiency was found in 28.5% of patients. Vitamin D deficiency was found in 62.6% of patients.

Conclusion: Vitamin D deficiency is common in elderly female patients with hip fractures and is associated with age and DM. This initial work warrants further larger-scale studies of vitamin D variations.

Keywords

Vitamin D, Hip Fracture, Orthopaedic, Diabetes Mellitus.

Check for updates

Introduction

Vitamin D deficiency is associated with increased muscle weakness and pain leading to reduced strength, balance, and function[1]; increased bone turnover[2,3], and increased risk of falls and hip fractures in older adults[4]. Elderly people are at greater risk of vitamin D deficiency because of risk factors such as suboptimal sunlight exposure and the lower cutaneous synthesis of vitamin D, reduced dietary intake of D2 (ergocalciferol) and D3 (cholecalciferol), impaired intestinal absorption, and impaired hydroxylation in the liver and kidneys[1]. In Western countries, Vitamin D deficiency occurs especially in the early spring due to reduced cutaneous synthesis during winter months[5,6] in housebound individuals[7], and medical inpatients[8].

A Turkish study had shown that patients living in old age homes had a higher risk of vitamin D deficiency than those living in their own homes. The same study found that clothing habits and exposure to sunlight were also associated with a higher risk of vitamin D deficiency[9]. The prevalence of vitamin D deficiency is even higher in elderly patients with fragility fractures (varying from 55 % to 91.6%)[6,10-13], that was 57.5% among hospitalized elderly patients with hip fracture[14]. In 2000, there were an estimated 1.6 million hip fractures worldwide, and mortality in the year following a hip fracture is estimated at 20-30 %[13,14]. The social and economic burden of hip fractures worldwide is expected to increase significantly over the next 50 years due to aging populations, especially within developing countries[15-17]. Identifying interventions that can prevent hip fractures remains a key research priority, and vitamin D is an appealing therapy to fulfill this role.

In the face of the continuing uncertainty and the need for firm evidence to guide practice, up to date and broader quantitative examination of the evidence regarding vitamin D and fracture is warranted. Shrier et al. suggest that the advantages of examining different levels of evidence by including observational studies with Randomized control trials in meta-analyses may outweigh the disadvantages[18]. In a community-based study of 901 mother and offspring pairs, researchers found that maternal vitamin D deficiency (serum 25-hydroxyvitamin D < 50 nmol/L) at 18 weeks' pregnancy was associated with impaired lung development at age 6 in offspring, neurocognitive difficulties at age 10, increased risk of eating disorders in adolescence, and lower peak bone mass at age 20[12-14].

There is a paucity of data on the prevalence of vitamin D levels in female patients with hip fractures. Numerous studies are available where sun exposure is scarce; however, in countries where sun exposure is abundant, data is deficient. Although females were found to have more Vitamin D deficiency than males, there was no statistically significant difference observed. In our part of the world, females with full-body coverage tend to be at home in the majority of the cases, so our study's result may differ compared to other countries. Therefore, the present study's objective was to determine the frequency of vitamin D levels in females with hip fractures presenting to a tertiary care facility in Karachi, Pakistan.

Methodology

A cross-sectional study was conducted in the Department of Orthopaedic Surgery, Jinnah Postgraduate Medical Center, Karachi, for six months from 17th May to 16th November 2016. Ethical approval was obtained from the College of Physicians & Surgeons of Pakistan and the Ethical Review Committee of JPMC. Informed consent was obtained from patients. The study's objective, procedure, risk, and benefit were explained to participants and confidentiality was assured and maintained throughout the study.

Consecutive female patients with the age between 45-75 years with duration of fracture ≤ 04 weeks admitted through the emergency department of JPMC meeting the inclusion criteria were included in the study while Patients with End-Stage Renal Disease (ESRD) requiring Renal Replacement Therapy (RRT) (GFR < 15) and high-impact injuries were excluded from the study. Patient's demographics like age, occupation, education level, and comorbidities like DM, HTN, and Vitamin D levels were sent to the institutional laboratory.

The patient's vitamin D profile along with the demographics was noted and entered in the study record sheet.

Data were entered into SPSS version 20.0. Quantitative variables like age, vitamin D level, the weight of the patient, height, and BMI were given as mean and standard deviation. Frequencies and percentages were expressed for qualitative variables i.e. marital status, residence background (rural/urban), menstrual phase (premenopausal /postmenopausal), cause of fracture (Fall/RTA), housing, clothing (Burqa/Abaya), occupation, educational level, comorbidities like DM, HTN, and Vitamin D sufficiency, insufficiency and deficiency.

Stratification was done to see the effect of the modifiers on the outcome variable. Post-stratification Chi-square test was applied and, a p-value < 0.05 was taken as significant.

Results

Out of 123 study subjects, 79.7 % were from urban areas, while 20.3 % were from rural areas. It was also observed that 63.4 % of study subjects were living in cemented houses while the rest of 36.6 % were living in non-cemented houses and, most of the females (84.6 %) were in the postmenstrual phase.

Around 62.6 % were of average weight, 33.3 % were overweight, and 4.1 % were obese. The mean duration of fracture was 12.27 ± 5.84 days, and the leading cause of fracture in most patients was Road Traffic Accidents (RTAs). DM was found in 47.2 % of patients, whereas 54.5 % were suffering from HTN. It was found that only 8.9 % of patients had sufficient vitamin D level, insufficiency was found in 28.5 % while 62.6 % of patients were observed with Vitamin D deficiency (Table 1).

Table 1: Demographic characteristics of study participants.

Variables		Mean±SD	
Age	≤ 60 Years(n=63)	52.46±4.51	
	> 60 Years (n=60)	68.58±3.99	
Duration of Fracture	≤12 Days (n=63)	7.33±3.27	
	> 12 Days (n=60)	17.46±2.45	
Weight (kg)		62.78±6.48	
Height (cm)		159.93±5.55	
BMI (kg/m^2)		24.57±2.77	
Vitamin D level (ng/ml)		18.28±8.10	
		N	%
Residence	Urban	98	79.70
	Rural	25	20.30
Type of House	Cemented	78	63.40
	Not Cemented	45	36.60
Occupation	House Wife	102	82.90
	Working Women	21	17.10
Education Status	Illiterate	24	19.50
	Primary	23	18.70
	Secondary	32	26
	Matric	26	21.10
	Intermediate or Above	18	14.60
Menstrual Phase	Pre Menstrual phase	19	15.40
	Post Menstrual phase	104	84.60
BMI Group	Normal	77	62.60

	Overweight	41	33.30
	Obese	5	4.10
	Yes	53	43.10
	No	70	56.90
Cause of Fracture	RTA	89	72.40
	Fall	34	27.60
Diabetes Mellitus	Yes	58	47.20
	No	65	52.80
Hypertension	Yes	67	54.50
	No	56	45.50

Vitamin D association with clinical determinants

The results showed significant association of vitamin D levels with age (p=0.011) and DM (p=030). No significant association of vitamin D levels was observed with duration (p=0.654), education status (p=0.072), BMI (p=0.785), residence (p=0.305), housing (p=0.810), occupation (p=0.261), menstrual phase (p=0.293), clothing (p=0.405), causes of fracture (p=0.2420), and HTN (p=0.658).

Table 2: Association of vitamin D levels with baseline characteristics.

Variables		Vitamin D levels			p-value
		Sufficient (n=11)	Insufficient (n=35)	Deficient (n=77)	
Age	≤ 60 years (n=63)	1	21	41	0.011*
	> 60 years (n=60)	10	14	36	
Duration of Fracture	≤ 12 days (n=63)	6	20	37	0.654
	> 12 days (n=60)	5	15	40	
BMI (kg/m^2)	Normal (n=77)	9	22	46	0.785
	Overweight(n=41)	2	12	27	
	Obese(n=5)	0	1	4	
Residence	Urban (n=98)	7	30	61	0.305
	Rural (n=25)	4	5	16	
Type of House	Cemented (n=78)	8	21	49	0.810
	Non Cemented (n=45)	3	14	28	
Occupation	House Wife (n=102)	11	27	64	0.261
	Working Women (n=21)	0	8	13	
Education Status	Illiterate (n=24)	1	12	11	0.072
	Primary (n=23)	1	6	16	
	Secondary (n=32)	2	5	25	
	Metric (n=26)	5	5	16	
	Intermediate or Above (n=18)	2	7	9	
Menstrual Phase	Pre Menstrual phase (n=19)	0	7	12	0.293
	Post Menstrual phase (n=104)	11	28	65	
Clothing (Burqa/Abaya)	Yes (n=53)	6	12	35	0.405
	No (n=70)	5	23	42	

Cause of Fracture	RTA (n=89)	6	24	59	0.242
	Fall (n=34)	5	11	18	
Diabetes Mellitus	Yes (n=58)	9	18	31	0.030*
	No (n=65)	2	17	46	
Hypertension	Yes (n=67)	5	21	41	0.658
	No (n=56)	6	14	36	

*P-value ≤0.05 considered a significant

Discussion

Vitamin D deficiency is common in the elderly, especially in patients with hip fracture. Older adults infrequently stay outside in the sunshine, and nutrition is deficient in vitamin D. Also, the hydroxylation of vitamin D into active metabolites decreases with age. Vitamin D deficiency ultimately leads to osteomalacia, but in an earlier stage, it causes secondary hyperparathyroidism, which is accompanied by increased bone turnover and cortical bone loss. Along with these pathways, vitamin D deficiency may contribute to the pathogenesis of hip fractures[19].

Vitamin D supplementation is widely considered an essential therapy for preventing fracture, and use for this purpose is both widespread and recommended, with and without calcium[20-22]. A study showed that hypovitaminosis D is common in older patients presenting with hip fractures. In our study of patients with hip fracture, 62.6 % had vitamin D deficiency and 28.5 % had vitamin D insufficiency with only 8.9 % of patients with hip fracture having sufficient vitamin D levels which are almost similar to Ramason et al according to which 57.5 % had vitamin D deficiency and 34.5 % vitamin D insufficiency, with only 8 % of patients with hip fracture having sufficient vitamin D levels[14]. This is also comparable to deficiency and insufficiency levels found in Western patients with hip fracture[11,23,24]. The predominance of female patients with hip fractures also mirrors that seen in Western countries[25] & Ramason et al. study[14]. The finding that the housebound state carried a significantly greater risk of vitamin D deficiency compared to previously community ambulant elderly patients with hip fracture has also been previously reported[25]. This group of frailer housebound patients is more likely to have less sun exposure as they are not only confined indoors due to reduced physical activity but are also likely to have other risk factors, such as the reduced dietary source of vitamin D as well as coexisting illnesses (such as the liver and renal impairment) that could contribute to vitamin D deficiency.

Interestingly, patients with hip fracture previously residing in nursing homes before admission were not significantly associated with vitamin D deficiency. We postulate that the small sample size could explain this unexpected finding. A Turkish study had shown that patients living in old age homes had a higher risk of vitamin D deficiency than those living in their own homes. The same study found that clothing habits and exposure to sunlight were also associated with a higher risk of vitamin D deficiency[9].

In the literature, we found the levels of vitamin D deficiency to be 90.5 % in Malay patients with hip fracture compared to 55% of Chinese and 61.1% Indian patients with hip fractures. Darker skin pigmentation is associated with low vitamin D levels, and the presence of genetic factors may have resulted in increased 24-hydroxylase activity in Indians. We postulate that this could be related to the religious-cultural practice of dressing style (long sleeves, headdress for Muslim-Malay females). This avoidance of sunlight by the Malays could account for the lower vitamin D levels. Similar findings of Malays being at greater risk of vitamin D deficiency than the Chinese were also shown in a recent study in Singapore by Hawkins[26], although this was in a younger population. Studies have shown a high prevalence of vitamin D deficiency (49.4 %-100 %) in healthy young women in the Middle East despite abundant sunlight, and conservative clothing style has been identified as a risk factor[27,28]. This is an exciting finding that merits

further study for vitamin D genetic polymorphisms, environmental factors, and clothing habits, accounting for the ethnic differences observed. In our study, clothing (Burqa/Abaya) was used by 43.1 % of females.

The actual definition of vitamin D deficiency is also not universally agreed upon, and cutoffs have been known to vary from 12 to 30 µg/L. The Institute of Medicine has defined serum vitamin D levels of 20 µg/L as adequate and less than 12 µg/L as deficient[29]. Holick and the Endocrine Society Clinical Practice Guideline has defined vitamin D deficiency as <20 µg/L and insufficiency as 21 to 29 µg/L[30]. In this study, we took <20 µg/L to be vitamin D deficient, which is also similar to Ramason et al. study[14].

Hip fracture is the most severe outcome of osteoporosis and an important and increasing health problem. It is common amongst older individuals and is associated with significant morbidity and mortality. In 2000, an estimated 1.6 million hip fractures world-wide[31] and mortality in the year following a hip fracture was estimated at 20-30 %[32]. The social and economic burden of hip fractures worldwide is expected to increase significantly over the next 50 years due to aging populations, especially within developing countries[33-35]. Identification of interventions that can prevent hip fractures remains a key research priority, and vitamin D is an appealing therapy to fulfill this role.

Conclusion

This is an observational study and lacks randomization. The present study's main limitations include a single-center experience, a small sample size, and data collected from the urban environment only. Therefore, the results might not be generalizable to larger populations. In conclusion, this study confirms that vitamin D deficiency is common in elderly female patients with hip fractures and is associated with age and DM. This initial work warrants further larger-scale studies of vitamin D variations.

Conflicts of Interest

None.

Acknowledgment

The authors would like to acknowledge Dr. Saima Khan for her scientific input.

Funding

None.

References

1. Horlick MF. Vitamin D deficiency. N Engl J Med. 2007;357(3):266-281.
2. Mezquita Raya P, Muñoz Torres M, De Dios Luna J, Luna V, Lopez Rodriguez F, Torres Vela E, Escobar Jiménez F. Relation between vitamin D insufficiency, bone density, and bone metabolism in healthy postmenopausal women. J Bone Miner Res. 2001;16(8):1408-1415.
3. Ooms ME, Roos JC, Bezemer PD, van der Vigh WJ, Bouter LM, Lips P. Prevention of bone loss by vitamin D supplementation in elderly women: a randomized double-blind trial. J Clin Endocrinol Metab. 1995;80(4):1052-1028.
4. Cauley JA, LaCroix AZ, Wu L. Serum 25-Hydroxyvitamin D Concentrations and Risk for Hip Fractures. Ann Intern Med. 2008;149(4):242-250.
5. Looker AC, Dawson Hughes B, Calvo MS. Serum 25-hydroxyvitamin D status of adolescents and adults in two seasonal subpopulations from NHANES III. Bone. 2002;30(5):771-777.
6. Nurmi I, Kaukonen JP, Lüthje P, Naboulsi H, Tanninen S, Kataja M, Kallio ML, Leppilampi M. Half of the patients with an acute hip fracture suffer from hypovitaminosis D: a prospective study in southeastern Finland. Osteoporos Int. 2005;16(12):2018-2024.
7. Lips P. Vitamin D deficiency and secondary hyperparathyroidism in the elderly: consequences for bone loss and fractures and therapeutic implications. Endocr Rev. 2001;22(4):477-501.
8. Thomas MK, Lloyd-Jones DM, Thadhani RI, Shaw AC, Deraska DJ, Kitch BT, Vamvakas EC, Dick IM, Prince RL, Finkelstein JS. Hypovitaminosis D in medical inpatients. N Engl J Med. 1998;338(12):777-783.
9. Atli T, Gullu S, Uvsal AR, Erdogan G. The prevalence of Vitamin D deficiency and effects of ultraviolet light on vitamin D levels in elderly Turkish population. Arch Gerontol Geriatr. 2005;40(1):53-60.

10. Gallacher SJ, McQuillian C, Harkness M, Finlay F, Gallagher AP, Dixon T. Prevalence of vitamin D inadequacy in Scottish adults with vertebral fragility fractures. Curr Med Res Opin. 2005;21(9):1355-1361.
11. Moniz C, Dew T, Dixon T. Prevalence of vitamin D inadequacy in osteoporotic hip fracture patients in London. Curr Med Res Opin. 2005;21(12):1891-1894.
12. Beringer T, Heyburn G, Finch M, McNally C, McQuilken M, Duncan M, Dixon T. Prevalence of vitamin D inadequacy in Belfast following fragility fracture. Curr Med Res Opin. 2006;22(1):101-105.
13. LeBoff MS, Kohlmeier L, Hurwitz S, Franklin J, Wright J, Glowacki J. Occult vitamin D deficiency in postmenopausal US women with acute hip fractures. JAMA. 1999; 281(16):1505-1011.
14. Ramason R, Selvaganapathi N, Ismail NH, Wong WC1, Rajamoney GN2, Chong MS. Prevalence of vitamin d deficiency in patients with hip fracture seen in an orthogeriatric service in sunny Singapore. Geriatr Orthop Surg Rehabil. 2014; 5(2):82-86.
15. Hollis BW, Wagner CL. Normal serum vitamin D levels. N Engl J Med. 2005; 352(5):515-518.
16. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, Murad MH, Weaver CM. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011; 96(7):1911-1930.
17. Weishaar T, Rajan S, Keller B. Probability of Vitamin D Deficiency by Body Weight and Race/Ethnicity. J Am Board Fam Med. 2016; 29(2):226-232.
18. Haddad JG, Matsuoka LY, Hollis BW, Hu YZ, Wortsman J. Human plasma transport of vitamin D after its endogenous synthesis. J Clin Invest. 1993; 91(6): 2552-2555.
19. Lips P, Netelenbos JC. Vitamin D deficiency and hip fracture. Tijdschrift voor gerontologie en geriatrie. 1985;16(6):239-245.
20. Working Group of the Australian and New Zealand Bone and Mineral Society, Endocrine Society of Australia and Osteoporosis Australia: Vitamin D and adult bone health in Australia and New Zealand: a position statement. Med J Aust. 2005;182(6):281-285.
21. Bischoff-Ferrari HA: How to select the doses of vitamin D in the management of osteoporosis. Osteoporos Int. 2007;18(4):401-407.
22. Qaseem A, Snow V, Shekelle P, Hopkins R, Forciea MA, Owens DK: Pharmacologic treatment of low bone density or osteoporosis to prevent fractures: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2008;149 (6):404-415.
23. Gallacher SJ, McQuillian C, Harkness M, Finlay F, Gallagher AP, Dixon T. Prevalence of vitamin D inadequacy in Scottish adults with vertebral fragility fractures. Curr Med Res Opin. 2005;21(9):1355–1361 (10)
24. Bischoff-Ferrari HA, Can U, Staehelin HB, Platz A, Henschkowski J, Michel BA, Dawson-Hughes B, Theiler R. Severe vitamin D deficiency in Swiss hip fracture patients. Bone. 2008; 42(3):597-602.
25. Gloth FM III, Gundberg CM, Hollis BW, Haddard JG, Jr, Tobin JD. Vitamin D deficiency in homebound elderly persons. JAMA. 1995;274(21):1683–1686.
26. Hawkins RC. 25-OH VitaminD3 Concentrations in Chinese, Malays, and Indians. Clin Chem. 2009;55(9):1749–51.
27. Al-Mogbel ES. Vitamin D status among adult Saudi Females visiting primary health care clinics. Int J Health Sci (Qassim). 2012;6(2):116–126.
28. Golgahar J, Al-Saffar N, Altayab Diab D, Al-Othman S, Darwish A, Al-Kafaji G.. Predictors of vitamin D deficiency and insufficiency in adult Bahrainis: a cross-sectional study. Public Health Nutr. 2014;17(4):732–738.
29. Leino A, Turpeinen U, Koskinen P. Automated measurement of 25-OH vitamin D3 on the Roche Modular E170 analyzer. Clin Chem. 2008;54(12):2059–2062.
30. Del Valle HB, Yaktine AL, Taylor CL, Ross AC, editors. Dietary reference intakes for calcium and vitamin D. National Academies Press; 2011.
31. Johnell O, Kanis JA: An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006, 17(12): 1726-1733.
32. Johnell O, Kanis J: Epidemiology of osteoporotic fractures. Osteoporos Int. 2005; 16 (Suppl 2): S3-7.10.
33. Cooper C, Campion G, Melton LJ: Hip-Fractures in the Elderly - a Worldwide Projection. Osteoporos Int. 1992; 2(6);285-289.
34. Gullberg B, Johnell O, Kanis JA: Worldwide projections for hip fracture. Osteoporosis Int. 1997;7(5):407-413.
35. Harvey N, Dennison E, Cooper C: Osteoporosis: impact on health and economics. Nat Rev Rheumatol. 2009; 6(2):99-105.