



## Original Research Article

## Association of calcium and Vitamin D levels in fragility fractures in the elderly: A study in a tertiary care centre

S. Rajesh Kumar<sup>1</sup>, Samudrala Sreenivas<sup>1,\*</sup>, Ashwin Kasturi<sup>1</sup>

<sup>1</sup>Dept. of Orthopedic, RVM Institute of Medical Science and Research Centres, Laxmakkapally, Telangana, India



## ARTICLE INFO

## Article history:

Received 19-05-2020

Accepted 09-06-2020

Available online 17-07-2020

## Keywords:

Calcium

Vitamin D

Fragility fractures  
elderly

## ABSTRACT

**Introduction:** One of the most common morbidities that is associated with the elderly is the fragility fractures. The common areas where the fragility fractures occur are pelvis, forearm and ribs in the elderly especially the persons aged more than 65 years. Of the various lines of treatments available for osteoporosis, one of the primary managements are Calcium and Vitamin D. This study was done therefore to assess the levels of vitamin D among the elderly with fragility fractures.

**Materials and Methods:** 76 patients over the age of 60 years, who had been admitted in our hospital due to fragility fractures, who were mobile, either independently or with help such as stick, walking frame or wheel chair were included into the study. The Vitamin D<sub>3</sub> levels were classified as sufficient, insufficient and deficient based on Pearce et al classification. Statistical analysis using graphs and tables and fisher's test was done.

**Results:** Out of 76 patients, 27.6% were males and 72.4% were females and the mean age was 75.9 ± 4.6. Majority of the patients with fractures (47.4%) were either walking with 2 sticks or with a walking frame at the time of their fall. 56.6% of the patients had insufficient Vitamin D levels in their blood stream, 23.7% had deficient levels (<25 nmol/lit), 14.5% had sufficient levels and 5.3% were in the optimal range (>75 nmol/lit).

**Conclusion:** Most of the patients were either had insufficient or deficient Vitamin D level at the time of their fall. Therefore, it is imperative to keep a watch on the vitamin D levels and supplement calcium and vitamin D in medications so that the risk of fall is reduced.

© 2020 Published by Innovative Publication. This is an open access article under the CC BY-NC license (<https://creativecommons.org/licenses/by-nc/4.0/>)

### 1. Introduction

One of the most common morbidities that is associated with the elderly is the fragility fractures. The main cause of fragility fractures is due to osteoporosis.<sup>1</sup> Osteoporosis is a very common skeletal disease the results in progressive destruction of the skeletal mass and the microarchitecture of the bone.<sup>1</sup> Osteoporosis is estimated to occur in 50% of the females and in 20% of the males worldwide. It is thus, one of the most commonly encountered conditions.<sup>2</sup> The most common complication due to the fragility fractures is death. There has been a marked increase of 3.17 times risk of death in the first year after a fragility hip fracture. In case

of vertebral fracture, the risk of death is 2.71 times in the second year.<sup>3</sup>

Osteoporosis is of two types- primary osteoporosis, which is due to the normal ageing of the individual, which usually results in the lowered levels of estrogen, and secondary osteoporosis which is due to other diseases such as low Vit D levels, diabetes type 2, cardiovascular disease and others.<sup>4-6</sup> The causes of osteoporosis can be a mix of genetic, metabolic and environmental factors such as alcohol consumption, smoking, low physical activity, low sun exposure. Medications such as anticonvulsants and glucocorticoids also have a great affect on osteoporosis.<sup>7</sup> The common areas where the fragility fractures occur are pelvis, forearm and ribs in the elderly especially the persons aged more than 65 years. In such patients, the morbidity is

\* Corresponding author.

E-mail address: cpmreddy@gmail.com (S. Sreenivas).

high, with severe health and social problems not to mention the increase in expenditure.<sup>8</sup> Hip fractures are usually associated with chronic pain, disability, reduced mobility of the person and therefore a longtime nursing care, with increased mortality rate. The mortality rate is more common in men than women.<sup>9–14</sup>

Therefore, the prevention and the treatment of these fragility fractures is very important to reduce the morbidity and mortality of the patients. Of the various lines of treatments available for osteoporosis, one of the primary managements are Calcium and Vitamin D.<sup>15</sup> Bone consists of a very high density of calcium and this is dependant on the intake of calcium during adolescence. As the age progresses, the density begin to slowly reduce. A high intake in the younger years will help in the slow age related loss of calcium in the body.<sup>16–19</sup> Inadequate intake of calcium will increase the prevalence of osteoporosis as the age advances.<sup>20</sup> Vitamin D is one of the important agents which helps in the absorption of calcium in the body, and also reduces with age.<sup>21</sup> Apart from calcium homeostasis, Vitamin D also is reported to have an effect on the muscular strength, receptors of which are expressed in the skeletal muscle tissue. Studies have shown that lower levels of Vit D are associated with a higher risk of falls and fractures.<sup>22,23</sup>

The normal dosage of the supplementation in elderly is 1200 IU of calcium and 800IU of Vit D per day.<sup>24–26</sup> Vit D insufficiency is classified into mild, moderate and severe. Mild insufficiency ranges from 25-50 nmol/l of serum 25OHD, moderate is 12.5-25 nmol/l and severe is <12.5nmol/l.

This study was done therefore to assess the levels of vitamin D among the elderly with fragility fractures.

## 2. Materials and Methods

This prospective hospital based study was done by the Department of Orthopedics at RVM institute of medical sciences and research center from November 2019 to April 2020. 76 patients over the age of 60 years, who had been admitted in our hospital due to fragility fractures were included into the study. All the persons who were included were mobile, either independently or with help such as stick, walking frame or wheel chair. Those bedridden persons who sustained fractures due to falling off were excluded from the study. All the subjects had no serious medical ailments and had a life expectance of another 10 years. Persons who received drugs which can alter the bone metabolism were excluded, such as corticosteroids, anticonvulsants, thyroxine or fluoride salts.

This study was done after the approval of the institutional ethical committee clearance and after attaining the informed consent from all the subjects. The demographic details such as age, height, weight, Body Mass Index was collected from all the patients. They were subjected to medical and clinical analysis. The nature and the extent of the fracture

was confirmed by X-Ray of the concerned area. Blood was collected and regular investigations such as hemoglobin, complete blood picture, random blood sugar, cholesterol alkaline phosphatase, creatinine were done using standard methods.

The Vitamin D<sub>3</sub> levels were classified as sufficient, insufficient and deficient based on Pearce et al classification<sup>1</sup>. Statistical analysis using graphs and tables and fisher's test was done.

## 3. Results

76 patients with fragility fractures in different parts of the body were included into the study. Out of them, 21 (27.6%) were males and 55 (72.4%) were females (Figure 1).

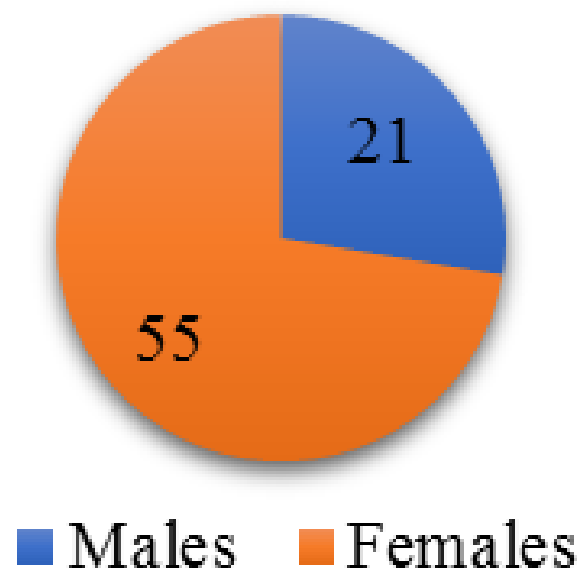


Fig. 1: Gender categorization of the patients

All the patients included in the study were above 60 years of age, the mean was  $75.9 \pm 4.6$ , with the range being 60 – 92 years, the oldest being 92 years old. The BMI was measured for all the patients based on the height and weight. Out of the 21 males, 1 (4.8%) was underweight, with a BMI of <18.5, 5 (23.8%) had a normal BMI, 14 (66.7%) were overweight while 1 (4.8%) was obese. Among the women, 5 (9.1%) was underweight, 11 (20%) had normal BMI, 26 (47.3%) were overweight, 13 (23.7%) were obese. This data showed that there was a significant relation to a higher BMI and fragility fractures (Table 1).

Majority of the patients with fractures (47.4%) were either walking with 2 sticks or with a walking frame at the time of their fall. 11 (14.5%) of the patients were independently walking, without any support, while 25 (32.9%) of them were walking with slight support, mostly with the help of a stick. In some cases, an attender or a family member aided the patient to walk. 4 (5.3%) of them

**Table 1:** General details of the patients

Variables	Males n= 21	Females n=55
Mean Age	75.9 ± 4.6	72.4 ± 7.1
Mean weight (kgs)	82.67 ± 9.1	74.66 ± 4.6
<b>BMI</b>		
Underweight (<18.5)	1 (4.8%)	5 (9.1%)
Normal (18.5 – 24.9)	5 (23.8%)	11 (20%)
Overweight (25.0 – 29.9)	14 (66.7%)	26 (47.3%)
Obese (>30)	1(4.8%)	13 (23.7%)

were on a wheelchair (Table 2).

**Table 2:** Mobility of the patients

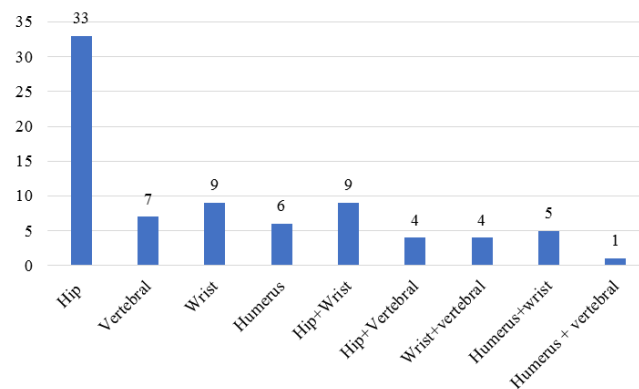
Mobility	Number	Percentage
Unaided walk	11	14.5%
Walk with help / 1 stick	25	32.9%
Walk with 2 sticks/ frame	36	47.4%
Wheelchair	4	5.3%

At the time of admission, 43 (56.6%) of the patients had insufficient Vitamin D levels in their blood stream, 18 (23.7%) had deficient levels (<25 nmol/lit). 11 (14.5%) had sufficient levels and 4 (5.3% were in the optimal range (>75 nmol/lit) (Table 3)

**Table 3:** Classification of Vit D levels in patients

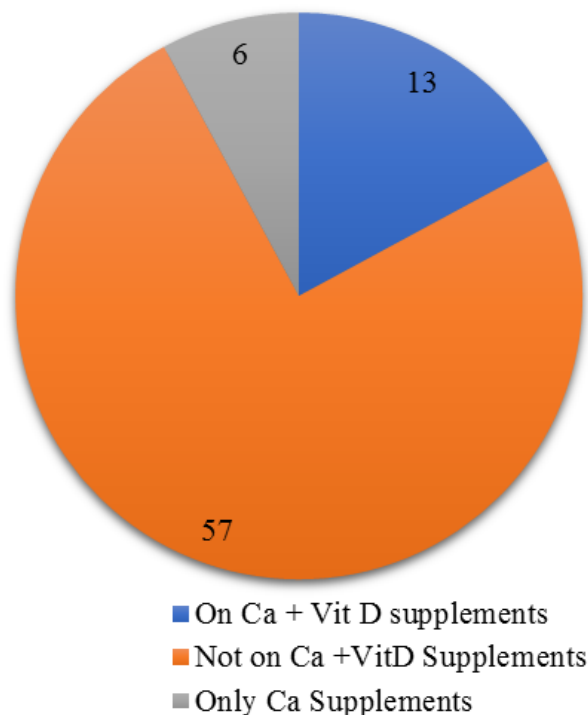
Vit D Levels	Number	Percentage
Optimal (>75 nmol/lit)	4	5.3%
Sufficient (50-75 nmol/lit)	11	14.5%
Insufficient (25-50 nmol/lit)	43	56.6%
Deficient (<25 nmol/lit)	18	23.7%

Most of the patients were admitted due to fracture of the hip during the fall, which was seen in 33 (43.4%). 9 (11.8%) each had fracture of the wrist or hip and wrist, followed by 7 (9.2%) with vertebral fractures (Figure 2 ).



**Fig. 2:** Location of fracture

At the time of admission, majority of the patients 57 (75%), were not on any supplements, neither calcium of calcium with Vit D. 13 (17.1%) however were taking Calcium as well as Vit D<sub>3</sub> supplements and 6 (7.9%) were taking only Calcium supplements (Figure 3).



**Fig. 3:** Supplements taken by the patients

#### 4. Discussion

Low vitamin D levels are very often seen in elderly patients along with low calcium levels. This results in fragility fractures in these patients, with severe morbidity and mortality.<sup>27</sup>

In the present study, the number of females were 2 to 3 times more than the males. A study by Saini et al reported the male to female ration to be 1:3.5,<sup>28</sup> however in other studies such as that by Gallacher et al found no significant difference with sex of the patient to be associated with lower vitamin D levels.<sup>29</sup> The mean age in our study was 75.9 years in males and 72.4 years in females. A study by Gallacher et al reported 80.5 years to be the mean age among the patients with osteoporosis.<sup>30</sup>

In our study, 47.4% of the patients were walking with 2 sticks or a frame prior to the fall and subsequent fracture and 32.9% were walking with help or a stick. In a similar study by Saini et al, 52% of the patients walked with the help of a stick and 11.8% of them walked with the help of 2 sticks or a frame.<sup>28</sup>

BMI seems to play an important role in the Vit D levels. Around 70% of the patients were either overweight or obese.

It has been reported that BMI is significantly associated with the Vitamin D deficiency and could be due to sequestration of Vit D in the compartments of the body fat, thereby reducing the bioavailable Vit D.<sup>30</sup>

The daily necessary levels of Vitamin D is 400-800IU. Most of it is attained from sunlight. As the age increases, the outdoor activities of the persons reduces. As the person spends more and more time indoors, the level of Vit D also reduces.

In our study, 56.6% of the patients had Vit D insufficiency and 23.7% were deficient in Vit D. In a study by Saini et al, around 76% of the patients had Vit D deficiency and 16% had insufficient Vit D. These values were higher than that of our study. Another study by Gallacher et al observed 82% to have vitamin D levels less than 70nmol/l and 72% below 50nmol/l.<sup>29</sup> Another study reported about 75% of the patients with the serum 25OHD <50 nmol/l and 68% with 25OHD of <30nmol/l.<sup>31</sup> The Vitamin D levels show regional variation. It has reported to be 36% in Finland,<sup>32,33</sup> around 50-80% in the US,<sup>34,35</sup> 40-70% in Britain,<sup>36</sup> as high as 90% in Japan.<sup>37,38</sup>

Most of the fragility fractures in our study (60.5%) involved the hip. Others involved vertebrae, wrist and humerus. Hip fractures were the most common type of fragility fractures. In a study by Saini et al, 51% of the patients had hip fractures.<sup>28</sup>

Studies have shown that Vitamin D, when administered alone does not have any affect in the prevention of fractures, but when given with calcium as a supplement, there is definitely a positive response.<sup>39,40</sup> Studies have shown that there was a significant difference between the persons who were on Vit D and Calcium supplementation to those without.<sup>28</sup>

It has been reported that elderly patients who have been given high doses of vit D and calcium supplements are at lower risk of falls and fractures.<sup>41</sup> This is because the Vit D is associated with the increase in muscle mass and strength. So a reduction in the vit D levels, would result in lower muscle strength and bone mass.<sup>42,43</sup> This muscle weakness is reversible, when Vit D is supplemented.<sup>44</sup>

## 5. Conclusion

Most of the patients were either had insufficient or deficient Vitamin D level at the time of their fall. Therefore, after the onset of menopause and especially in the elderly, it is imperative to keep a watch on the vitamin D levels and supplement calcium and vitamin D in medications so that the risk of fall is reduced. This will further reduce the morbidity, quality of life and cost of hospitalization of the patients.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

## References

1. Fischer V, Ignatius A, Haffner-Luntzer M, Amling M. Calcium and vitamin D in bone fracture healing and post-traumatic bone turnover. *Eur Cells Mater.* 2018;35:365–85.
2. Lippuner K, Johansson H, Kanis JA, Rizzoli R. Remaining lifetime and absolute 10-year probabilities of osteoporotic fracture in Swiss men and women. *Osteoporos Int.* 2009;20(7):1131–40.
3. Ioannidis G, Papaioannou A, Thabane L, Gafni A, Hodsman A, Kvern B, et al. The utilization of appropriate osteoporosis medications improves following a multifaceted educational intervention: the Canadian quality circle project (CQC). *BMC Med Educ.* 2009;9(1):54.
4. Kanis JA, Borgström F, Compston J, Dreinhöfer K, Nolte E, Jonsson L, et al. SCOPE: a scorecard for osteoporosis in Europe. *Arch Osteoporos.* 2013;8(1-2):144.
5. Ralston SH, G A. Uitterlinden Genetics of osteoporosis. *Endocr Rev.* 2010;31(5):629–62.
6. Miazgowski T, Kleerekoper M, Felsenberg D, Stepan JJ. P Szulc Secondary osteoporosis: endocrine and metabolic causes of bone mass deterioration. *J Osteoporos.* 2012;p. 907214.
7. Lenchik L, Sartoris DJ. Current concepts in osteoporosis. *AJR Am J Roentgenol.* 1997;168(4):905–11.
8. Tuck SP, Francis RM. Best practice: osteoporosis. *Postgraduate Med J.* 2001;78:526–32.
9. Keene GS, Parker MJ, Pryor GA. Mortality and morbidity after hip fractures. *BMJ.* 1993;307:1248–50.
10. Ray NF, Chan JK, Thamer M, Melton LJ. Medical Expenditures for the Treatment of Osteoporotic Fractures in the United States in 1995: Report from the National Osteoporosis Foundation. *J Bone Miner Res.* 1997;12(1):24–35.
11. Farahmand BY, Michaëlsson K, Ahlbom A, Ljunghall S, Baron JA. Survival after hip fracture. *Osteoporos Int.* 2005;16(12):1583–90.
12. Empana JP, Dargent-Molina P, and GB. Effect of Hip Fracture on Mortality in Elderly Women: The EPIDOS Prospective Study. *J Am Geriatr Soc.* 2004;52(5):685–90.
13. Ensrud KE, Thompson DE, Cauley JA, Nevitt MC, Kado DM, Hochberg MC, et al. Prevalent Vertebral Deformities Predict Mortality and Hospitalization in Older Women with Low Bone Mass. *J Am Geriatr Soc.* 2000;48(3):241–9.
14. Center JR, Nguyen TV, Schneider D, Sambrook PN, Eisman JA. Mortality after all major types of osteoporotic fracture in men and women: an observational study. *Lancet.* 1999;353:878–82.
15. Reginster JY. Treatment of postmenopausal osteoporosis. *BMJ.* 2005;330:859–60.
16. Bonjour JP, Carrie AL, Ferrari S, Clavien H, Slosman D, Theintz G, et al. Calcium-enriched foods and bone mass growth in prepubertal girls: a randomized, double-blind, placebo-controlled trial. *J Clin Invest.* 1997;99(6):1287–94.
17. Heaney RP. Nutritional Factors in Osteoporosis. *Annu Rev Nutr.* 1993;13(1):287–316.
18. Lehtonen-Veromaa MK, Möttönen TT, Nuotio IO, Irjala KM, Leino AE, Viikari JS. Vitamin D and attainment of peak bone mass among peripubertal Finnish girls: a 3-y prospective study. *Am J Clin Nutr.* 2002;76(6):1446–53.
19. Valimaki MJ, Karkkainen M, Lamberg-Allardt C, Laitinen K, Alhava E, Heikkinen J, et al. Exercise, smoking, and calcium intake during adolescence and early adulthood as determinants of peak bone mass. *BMJ.* 1994;309:230–5.
20. Heaney RP. Calcium in the prevention and treatment of osteoporosis. *J Intern Med.* 1992;231(2):169–80.
21. Heaney RP, Gallagher JC, Johnston CC, Neer R, Parfitt AM, Whedon GD. Calcium nutrition and bone health in the elderly. *Am J Clin Nutr.* 1982;36(5):986–1013.

22. Holick MF. Vitamin D Deficiency. *N Engl J Med.* 2007;357(3):266–81.
23. Yao P, Sun L, Lu L. Effects of genetic and nongenetic factors on total and bioavailable 25(OH)D responses to vitamin D supplementation. *J Clin Endocrinol Metab.* 2017;102(1):100–10.
24. Ross AC, Manson JE, Abrams SA. The 2011 report on dietary reference intakes for calcium and vitamin D from the Institute of Medicine: what clinicians need to know. *J Clin Endocrinol Metab.* 2011;96(1):53–8.
25. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Evaluation, Treatment, and Prevention of Vitamin D Deficiency: an Endocrine Society Clinical Practice Guideline. *J Clin Endocrinol Metab.* 2011;96(7):1911–30.
26. Grossman DC, Curry SJ, Owens DK. US Preventive Services Task Force. Vitamin D, calcium, or combined supplementation for the primary prevention of fractures in community-dwelling adults: US Preventive Services Task Force recommendation statement. *JAMA.* 2018;319(15):1592–9.
27. 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.
28. Saini AK, Dawe EJC, Thompson SM, Rosson JW. Vitamin D and Calcium Supplementation in Elderly Patients Suffering Fragility Fractures; The Road not Taken. *Open Orthop J.* 2017;11(1):1230–5.
29. Gallacher SJ, McQuillan C, Harkness M, Finlay F, Gallagher AP, Dixon T, et al. Prevalence of vitamin D inadequacy in Scottish adults with non-vertebral fragility fractures. *Curr Med Res Opin.* 2005;21(9):1355–61.
30. Ducloux R, Nobécourt E, Chevallier JM, Ducloux H, Elian N, Altman JJ, et al. Vitamin D Deficiency Before Bariatric Surgery: Should Supplement Intake Be Routinely Prescribed? *Obes Surg.* 2011;21(5):556–60.
31. Sahota O. Hypovitaminosis D and functional hypoparathyroidism – the NoNoF (Nottingham Neck of Femur) study. *Antiageing.* 2001;30(6):467–72.
32. Lips P, Hackeng WHL, Jongen MJM, van Ginkel FC, Netelenbos JC. Seasonal Variation in Serum Concentrations of Parathyroid Hormone in Elderly People\*. *J Clin Endocrinol Metab.* 1983;57(1):204–6.
33. von Knorring J, Slätis P, Weber TH, Helenius T. Serum levels of 25-hydroxyvitamin D, 24,25-dihydroxyvitamin D and parathyroid hormone in patients with femoral neck fracture in southern Finland. *Clin Endocrinol.* 1982;17(2):189–94.
34. LeBoff MS. Occult Vitamin D Deficiency in Postmenopausal US Women With Acute Hip Fracture. *JAMA.* 1999;281(16):1505–11.
35. Glowacki J, Hurwitz S, Thornhill TS, Kelly M, LeBoff MS. Osteoporosis and vitamin-D deficiency among postmenopausal women with osteoarthritis un-dergoing total hip arthroplasty. *J Bone Joint Surg Am.* 2003;85(12):2371–7.
36. Baker MR, McDonnell H, Peacock M, Nordin BE. Plasma 25-hydroxy vitamin D concentrations in patients with fractures of the femoral neck. *Br Med J.* 1979;1(6163):589.
37. Sakuma M, Endo N, Oinuma T, Hayami T, Endo E, Yazawa T, et al. Vitamin D and intact PTH status in patients with hip fracture. *Osteoporos Int.* 2006;17(11):1608–14.
38. Nakano T, Tsugawa N, Kuwabara A, Kamao M, Tanaka K, Okano T. High prevalence of hypovitaminosis D and K in patients with hip fracture. *Asia Pac J Clin Nutr.* 2011;20(1):56–61.
39. Francis RM, Anderson FH, Patel S, Sahota O, Staa TPV. Calcium and Vitamin D in the prevention of osteoporotic fractures. *QJM: Int J Med.* 2006;99(6):355–63.
40. Trivedi DP. Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. *BMJ.* 2003;326(7387):469.
41. Bischoff-Ferrari HA, Dawson-Hughes B, Staehelin HB, Orav JE, Stuck AE, Theiler R, et al. Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials. *BMJ.* 2009;339(oct01 1):b3692.
42. Bischoff-Ferrari HA, Willett WC, Wong JB, Stuck AE, Staehelin HB, Orav EJ, et al. Prevention of Nonvertebral Fractures With Oral Vitamin D and Dose Dependency. *Arch Intern Med.* 2009;169(6):551–61.
43. Bischoff HA, Stähelin HB, Tyndall A, Theiler R. Relationship between muscle strength and vitamin D metabolites: are there therapeutic possibilities in the elderly? *Zeitschrift für Rheumatologie.* 2000;59(1):39–41.
44. Glerup H, Mikkelsen K, Poulsen L, Hass E, Overbeck S, Thomsen J, et al. Commonly recommended daily intake of vitamin D is not sufficient if sunlight exposure is limited. *J Int Med.* 2000;247(2):260–8.

## Author biography

**S. Rajesh Kumar** Assistant Professor

**Samudrala Sreenivas** Assistant Professor

**Ashwin Kasturi** Professor

**Cite this article:** Kumar SR, Sreenivas S, Kasturi A. Association of calcium and Vitamin D levels in fragility fractures in the elderly: A study in a tertiary care centre. *IP Int J Orthop Rheumatol* 2020;6(1):26-30.