

## HIP FRACTURES AND VITAMIN D: A SYSTEMATIC REVIEW

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### **Abstract**

**Introduction:** Hip fractures are among the most common types of fractures that patients report with to emergency departments and orthopaedic trauma teams. Study showed association vitamin D and bone intensity.

**The aim:** This article discusses association about hip fractures and vitamin D.

**Methods:** By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

**Result:** In the PubMed database, the results of our search brought up 218 articles, whereas the results of our search on SagePub brought up 109 articles. The results of the search conducted for the last year of 2013 yielded a total 88 articles for PubMed and 27 articles for SagePub. In the end, we compiled a total of 32 papers, 23 of which came from PubMed and nine of which came from SagePub. We included seven research that met the criteria.

**Conclusion:** Research consistently shows a link between vitamin D and bone strength. This is related to the incidence of hip fractures.

**Keyword:** Calcium; Fracutre; Hip; Vitamin D

## INTRODUCTION

Hip fractures are among the most common types of fractures that patients report with to emergency departments and orthopaedic trauma teams. The incidence of hip fractures worldwide was 1.3 million per year in 1990 and is projected to increase to 7 to 21 million by 2050. It is estimated that the annual incidence per 100,000 in the United States is between 197 and 201 for men and 511 and 553 for women. The average age of patients presenting with a hip fracture is 80 years old, as the incidence rises with age. A patient is estimated to spend \$40,000 in the first year following a hip fracture, and the annual cost of hip fracture care in the United States exceeds \$17 billion.<sup>1</sup>

The terms "hip fracture" and "neck of femur fracture" are interchangeable and refer to the same injury. Both phrases refer to a break in the proximal portion of the femur that occurs between the femoral head and a point that is 5 centimetres distal to the lesser trochanter.<sup>2,3</sup> The senior population has a significantly higher incidence of hip fractures as a direct consequence of falling. A past history of falls, gait irregularities, the use of walking aids, vertigo, Parkinson disease, and antiepileptic drugs are some of the risk factors for falls in the senior population.<sup>4</sup>

Although there are many risk factors for falls in this population, those having a significant independent association include those listed above. The underlying cause of the majority of hip fractures is age-related bone loss, which, together with the presence of several risk factors in many patients, contributes to a decreased bone quality. Hip fractures in younger adults are typically brought on by a traumatic event that used a great deal of force. It is highly possible that these individuals have sustained many injuries; therefore, they need to be evaluated and managed correctly in accordance with the local trauma guidelines.<sup>2,5</sup>

Approximately five percent of hip fractures have no previous history of trauma; in these instances, an alternate cause ought to be regarded as the culprit. A fracture that is not related to trauma and is instead produced by a disease process is what is referred to as a pathological fracture. Cancer and the usage of bisphosphonates are the two factors that contribute to hip fractures more frequently than any others. It is arguable that a much larger number of hip fractures could be classed as pathological if osteoporosis was the underlying cause; nevertheless, this group is rarely classified in this manner.<sup>5-7</sup>

There have been relatively few investigations into the efficacy and safety of a nutritional strategy to reducing the incidence of fractures in elderly people living in residential care facilities. Antifracture efficacy was demonstrated by Chapuy and colleagues using pharmaceutical dosages of calcium and vitamin D in female nursing home patients who had poor calcium intakes and vitamin D deficiencies.<sup>8</sup> Vitamin D may help keep bones healthy and strengthen them by making it easier for the body to absorb calcium, reducing secondary hyperparathyroidism, and slowing bone renewal.<sup>9</sup>

Vitamin D receptors and the activation of 1,25-dihydroxyvitamin D outside of the kidneys have been found in bone and linked to the development of osteoblast progenitors, which suggests a part in bone formation. Randomised, controlled trials that looked at the benefits of vitamin D supplements on fractures found mixed results. Some trials found evidence of benefit, no effect, or harm.<sup>9</sup> This article discusses association about hip fractures and vitamin D.

## METHODS

The author of this study made sure it met the standards by following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 rules. This is done to make sure that the results of the investigation are correct. For the objective of this literature review, we demonstrated an association between vitamin D and hip fractures. As the primary objective of this piece of writing, demonstrating the relevance of the identified challenges will occur throughout its entirety. In order to participate in the study, researchers were required to meet the following requirements: 1) The paper must be composed in English and will focus on osteosynthesis in patients with femoral neck fractures. For the manuscript to be considered for publication, it must satisfy both of these conditions. 2) Several of the examined papers were published after 2013, but prior to the time period deemed pertinent by this systematic review. Examples of studies that are not permitted include editorials, submissions without a DOI, previously published review articles, and entries that are essentially identical to previously published journal papers.

We used "hip fractures" and "vitamin D" as keywords. The search for studies to be included in the systematic review was carried out from July, 28<sup>th</sup> 2023 using the PubMed and SagePub databases by inputting the words: *((("hip fractures"[MeSH Terms] OR ("hip"[All Fields] AND "fractures"[All Fields]) OR "hip fractures"[All Fields]) AND ("vitamin d"[Supplementary Concept] OR "vitamin d"[All Fields] OR "ergocalciferols"[Supplementary Concept] OR "ergocalciferols"[All Fields] OR "vitamin d"[MeSH Terms] OR "ergocalciferols"[MeSH Terms])) AND ((y\_10[Filter]) AND (clinicaltrial[Filter])))* used in searching the literature.

In the PubMed database, the results of our search brought up 218 articles, whereas the results of our search on SagePub brought up 109 articles. The results of the search conducted for the last year of 2013 yielded a total 88 articles for PubMed and 27 articles for SagePub. In the end, we compiled a total of 32 papers, 23 of which came from PubMed and nine of which came from SagePub. We included seven research that met the criteria.

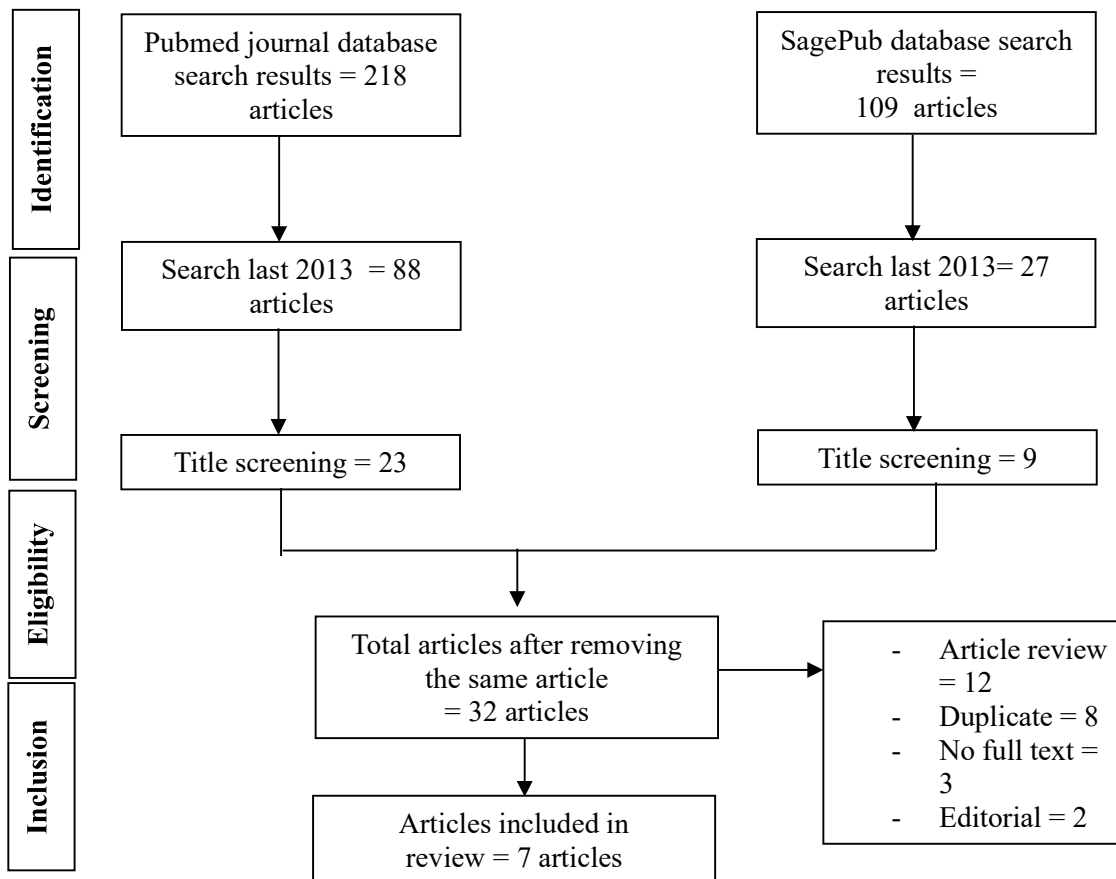


Figure 1. Article search flowchart

After perusing the abstract and title of each study, the authors conducted an evaluation to determine if the study met the inclusion criteria. The authors then determined which previous studies would serve as sources for the article and chose those studies. This conclusion was reached after examining a variety of studies that all appeared to indicate the same trend. All submissions must be written in English and must not have been previously published.

For the systematic review, only those papers that satisfied all inclusion criteria were considered. This narrows the search results to only those that are relevant to the query. We do not take into account the findings of any study that does not meet our standards. Following this, the research findings will be analysed in depth. As a consequence of the research conducted for the purpose of this study, the following information was uncovered: names, authors, publication dates, location, study activities, and parameters.

Before deciding which publications to investigate further, each author conducted their own research on the research included in the title and abstract of the publication. The next stage is to evaluate all of the articles that meet the review's inclusion criteria. Then, based on the findings, we will choose which articles to include in the review. This criterion is utilised in the selection of documents for further evaluation. To facilitate the process of selecting papers for evaluation as much as possible. This section discusses which earlier studies were conducted and what aspects of those studies made it appropriate to include them in the review.

**RESULT**

In the PubMed database, the results of our search brought up 218 articles, whereas the results of our search on SagePub brought up 109 articles. The results of the search conducted for the last year of 2013 yielded a total 88 articles for PubMed and 27 articles for SagePub. In the end, we compiled a total of 32 papers, 23 of which came from PubMed and nine of which came from SagePub. We included seven research that met the criteria.

**Table 1. The literature include in this study**

Author	Origin	Method	Sample Size	Result
Ingstad, 2021	Denmark	Cohort prospective study	872 participants	Low vitamin D at admission for hip fracture increased the risk of delirium, a new hip fracture, and medical readmissions, but not orthopedic complications. The role of vitamin D supplementation to prevent orthopedic complications requires further study.
Iuliano, 2021 <sup>10</sup>	Australia	Randomized clinical trial (RCT)	7,195 respondent	A widely available intervention that minimises the risk of falls and fractures that are regularly experienced by elderly care residents is increasing their calcium and protein intakes through the consumption of dairy foods.
Papapoulos, 2021 <sup>11</sup>	Netherland	Cohort prospective study	16,071 patients	These results provide insight into possible pathogenesis of atypical femur fracture (AFF), suggesting that the current criteria for diagnosing these fractures may need to be reconsidered.
Neale, 2021 <sup>12</sup>	Australia	Cohort prospective study	7,991 patients	It is essential to take measures to prevent vitamin D insufficiency; however, in order to determine whether this should be accomplished by greater sun exposure or increased supplementation, it is necessary to weigh the benefits, risks, and costs associated with each strategy.
Sprague, 2017 <sup>13</sup>	India	Cohort prospective study	573 patients	According to the findings of this research, supplementation with vitamin D after a hip fracture was connected with a statistically significant but not clinically meaningful improvement in the patient's overall quality of life related to their health.
Ramason, 2014 <sup>14</sup>	Singapore	Cohort prospective study	485 patients	In patients who have had a hip fracture in Singapore, inadequacy and insufficiency of vitamin D are very prevalent. Housebound individuals and people of Malay heritage were more likely to have vitamin D insufficiency, according to the study. It is possible that some clothing choices that limit one's exposure to sunshine will raise one's risk of vitamin D insufficiency.
Dhanwal, 2013 <sup>15</sup>	India	Cross sectional study	90 patients	Vitamin D insufficiency affects approximately three quarters of patients who have hip fractures, and secondary hyperparathyroidism affects around two thirds of these patients. As a result, the serum 25-OHD level has the potential to be an effective index for the evaluation of the risk of hip fracture in India.

Ingstad, et al (2021)<sup>16</sup> showed 47% patients with hip fractures had low vitamin D at baseline. They showed 18% developed delirium, and the risk was higher in vitamin D-deficient patients (odds ratio [OR] = 1.48, 95% confidence interval [CI] = 1.04-2.12; p = 0.03). Low vitamin D was associated with a higher risk of medical readmissions within 30 days (OR = 1.64 [1.03-2.61]; p = 0.036) and 12 weeks (OR = 1.47 [95% CI = 1.02-2.12]; p = 0.039). There was a higher risk of a new hip fracture (OR = 2.84 [95% CI 1.15-7.03;] p = 0.024) in vitamin D-deficient patients. A total of 105 (12%) developed at least one orthopedic complication, with no correlation to baseline vitamin D.

Iuliano, et al (2021)<sup>10</sup> conducted a study from 27 intervention facilities and 29 control facilities were analysed. A total of 324 fractures (135 hip fractures), 4,302 falls, and 1,974 deaths were observed. The intervention was associated with risk reductions of 33% for all fractures (121 v 203; hazard ratio [HR] = 0.67, 95% confidence interval [CI] = 0.48-0.93; P = 0.02), 46% for hip fractures (42 v 93; 0.54, 0.35-0.83; P = 0.005), and 11% for falls (1,879 v 2,423; 0.89, 0.78-0.98; P = 0.04). The risk reduction for hip fractures and falls achieved significance at five months (P = 0.02) and three months (P = 0.004), respectively. Mortality was unchanged (900 v 1,074; HR = 1.01, 0.43-3.08).

Papapoulos, et al (2021)<sup>11</sup> conducted a study with women aged ≥65 years with a bone mineral density (BMD) T-score ≤ -2.5 at the total hip (TH) or femoral neck (FN) or with a radiographic vertebral fracture and T-scores ≤ -1.5 at the TH or FN were randomized (1:1) to receive odanacatib (ODN) 50 mg/week or placebo. All patients received vitamin D3 (5,600 IU/week) and calcium (total 1,200 mg/d); the analysis included 16,071 women. Rates of all adjudicated low-energy femoral fractures were 0.38 versus 0.58/100 patient-years for ODN and placebo (HR = 0.65; 95% CI = 0.51-0.82;

$p < 0.01$ ), and for low-energy hip fractures were 0.29 versus 0.56/100 patient-years, respectively (HR = 0.52; 95% CI = 0.40–0.67;  $p < 0.01$ ).

The cumulative incidence of combined hip and ST/FS or hip fractures alone in the ODN group was consistently lower than in the placebo group (1.93% versus 3.11% for combined fractures and 1.53% versus 3.03% for hip fractures at 5 years, respectively). However, low-energy ST/FS fractures were more frequent in ODN-treated women than in placebo-treated women (24 versus 6, respectively). Among these, 12 fractures were adjudicated as AFF in 10 patients treated with ODN (0.03/100 patient-years) compared with none in the 6 placebo-treated women (estimated difference = 0.03; 95% CI = 0.02–0.06).<sup>11</sup>

Neale, et al (2021)<sup>12</sup> findings suggest that vitamin D deficiency contributes to a significant number of hospitalisations for falls and for the treatment of hip fracture in older Australians, even in a sunny country like Australia. In countries where vitamin D deficiency is more common, the impact will be even greater. It is crucial to reduce vitamin D insufficiency, but before supplementing with the vitamin or increasing sun exposure, weigh the advantages, disadvantages, feasibility, and costs of each strategy.

Sprague, et al (2017)<sup>13</sup> analysis included 573 patients. A total of 18.7% of participants reported no use of vitamin D, 35.6% reported inconsistent use, and 45.7% reported consistent use. Adjusted analysis found that consistent supplementation was associated with a 2.42 increase of the Short Form-12 physical component score 12 months postoperatively ( $P = 0.033$ ). However, supplementation was not associated with reduced reoperation rates ( $P = 0.386$ ). Despite guidelines recommending vitamin D supplementation, a low proportion of elderly patients with hip fracture use vitamin D consistently, suggesting a need for additional strategies to promote compliance.

Ramason, et al (2014)<sup>14</sup> conducted a study with 412 patients. There were 57.5% of people ( $n = 237$ ) who were deficient in vitamin D. There was a prevalence of vitamin D deficiency of 34.5 percent, with just 8.0 percent of patients having normal levels of vitamin D. The Malay race and functional characteristics (being housebound, requiring assistance with bathing and dressing) were found to be linked with vitamin D insufficiency in univariate analysis. However, in the multivariate model, the only factors that were significant were patients' ethnicity and whether or not they were housebound.

Dhanwal, et al (2013)<sup>15</sup> conducted a study with 90 patients. Comparing patients to controls, serum 25(OH)D and calcium levels were significantly lower, while intact PTH and ALP levels were substantially higher. Significant negative correlation was observed between serum 25(OH)D and PTH. In the group of subjects with hip fractures, 76.7% had vitamin D deficiency and 68.9% had secondary hyperparathyroidism. Vitamin D deficiency and elevated PTH levels were observed in 32.3% and 42.2% of the control group, respectively.

## DISCUSSION

This nutritional approach using high calcium and high protein dairy foods to increase calcium and protein intakes in institutionalised older adults replete in vitamin D reduced fracture risk by 33%, hip fracture risk by 46%, and fall risk by 11% compared to controls. All-cause mortality was similar among groups. Because osteoporosis patients are at high risk of fracture, most fracture prevention therapies involve medication therapy. Because few people need to be treated to prevent one occurrence, this technique provides a huge benefit to the person and is cost-effective. Averting fractures in a few high-risk individuals does not lower the community's fracture burden.<sup>10,13</sup>

Vitamin D is not really a "vitamin," but rather a potent precursor to the steroid hormone calcitriol known as 1,25-dihydroxyvitamin D3 (1,25(OH)2D3). Vitamin D mediates a variety of body tissue work.<sup>17</sup> Vitamin D3 is produced by the skin through UVB radiation which reaches 7-dehydrocholesterol in the skin which is followed by a thermal reaction. Vitamin D is a lipid-soluble vitamin, acting as a pleiotropic hormone in most human tissues by regulating mineral homeostasis and various other biological functions, including effects on immunity.<sup>18</sup>

The number of fractures, the number of people who get sick or die from them, and the cost to the community all come from the large number of people who have risk factors that only put them at a small risk. For example, most fragility fractures in the community happen to women with osteopenia (bone mineral density T score  $-2.5$  to  $-1$  SD) because they make up the biggest part of the community. Also, most fractures caused by poor nutrition happen to the large number of people whose calcium and protein intakes are below what is suggested.<sup>17,19</sup>

This lack of nutrition poses a small risk to the person, but it is responsible for a big part of the number of fractures in the community as a whole. This is the Geoffrey Rose prevention paradox: a community-based method that helps one person only a little bit can still help the whole community a lot.<sup>13</sup> Safety is important because the action may help most of the people treated very little or not at all. For example, the Dietary Approach to Stop Hypertension study found that substituting a "Western" diet with one that was high in fruit, vegetables, and low-fat dairy foods lowered blood pressure and was linked to fewer heart events.<sup>20,21</sup>



Most nutrition based studies assessing antifracture efficacy in aged care residents and people in the community used pharmacological doses of calcium with or without vitamin D. Reduction in fracture risk—a study of nursing home residents with calcium intakes <600 mg/day and vitamin D concentrations <50 nmol/L and a community based study in women and men ≥65 years of age with mean calcium intakes of 700 mg/day.<sup>17,22</sup> This change in diet led to two new findings that were not expected. The chance of falling and breaking a bone went down after three and five months, respectively.<sup>23</sup>

The relative risk reduction for fractures was similar to what was found in trials where strong antiresorptive therapy was used to treat people with osteoporosis who were at high risk. The two most likely reasons for each of these observations are a lower chance of falling and a slower rate of bone weakness getting worse. Insulin-like growth factor 1 only went up in the intervention group, while appendicular lean mass only went down in the control group. This is in line with the idea that older adults, especially those at risk of malnutrition or frailty, need protein intakes of 1-1.5 g/kg/day to prevent protein catabolism and keep or build muscle mass.<sup>24</sup>

In the control group, there was a rise in serum C-terminal telopeptide of type 1 collagen and a decrease in the total volumetric bone mineral density of the tibia and radius. This was not seen in the intervention group, which suggests that bone loss and microstructural damage were slowed. These changes were small, but stopping microstructural deterioration makes a big difference in how quickly bone fragility gets worse. This is because bone fragility gets worse as bone loss gets worse.<sup>23,24</sup>

## CONCLUSION

Research consistently shows a link between vitamin D and bone strength. This is related to the incidence of hip fractures.

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