

Cross sectional study on association between vitamin D levels and bone mineral density in elderly population

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Abstract

Background: Age-related osteoporosis is a major public health issue. Bone fractures are more likely to occur as a result of the health effects of this disease. A person's Bone Mineral Density (BMD) may change because vitamin D helps bones grow and maintains calcium levels. BMD and Vitamin D levels on older people are being studied.

Methods: Over the course of a year, this study looked at 100 older people at Shri Guru Ram Rai institute of medical and health sciences Patel Nagar. We were able to find out the BMD and 25(OH)D levels in the blood with Dual-energy X-ray Absorptiometry (DXA) study. Utilizing statistics, relationship among BMD as well as vitamin D was investigated.

Results: Varying degrees of vitamin D deficiency were observed among individuals. The average was 30.5 ng/mL (SD = 8.2). An important correlation ($p < 0.001$) was observed among vitamin D levels and BMD within the lower back, the neck of the femur, and the hip as a whole.

Conclusion: This is demonstrating of how important it is for older people to keep their bone health by getting enough vitamin D. If individuals consume an adequate amount of vitamin D, they may experience reduced bone strength loss and less frequent self-injury with maturity. To improve their bone health, older people need to get personalized care and should be checked often to make sure they are getting enough vitamin D.

Keywords: BMD, elderly population, osteoporosis, vitamin D.

INTRODUCTION

Osteoporosis is extremely detrimental to one's health, particularly as a person gets older [1]. This type of skeletal disease weakens bones and raises their susceptibility to fracture. As people get older, their BMD will naturally go down [2]. This increases the likelihood of experiencing bone fractures, complications, and a diminished quality of life.

Calcium balance and bone metabolism are two important functions of vitamin D, that has been an aspect of many studies on osteoporosis because it may help maintain BMD and prevent fractures [3].

Vitamin D and Bone Metabolism

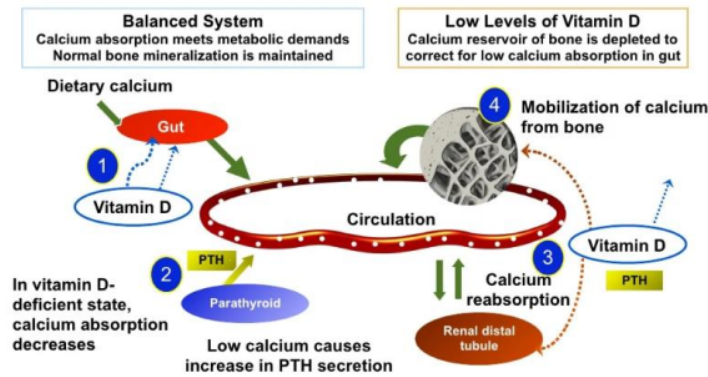


Figure 1 Vitamin D and Bone Metabolism(source:[3])

Background Information

A considerable number of individuals across the globe are afflicted with osteoporosis, and its prevalence increases with age. It appears when the processes by which bones are degraded and reconstructed are flawed. This results in bone mass loss and the formation of minute fissures in the structure [4]. Osteoporosis facilitates fractures of the spine, wrists, and hips, which are extremely expensive to repair. They exacerbate the susceptibility of numerous elderly individuals to illness and mortality. Vitamin D helps the body get calcium and keep bones strong. It can be found in food and vitamins, or the body can make it when it gets enough sun. Insufficiency of vitamin D may potentially impede the body's ability to absorb calcium. This could make weak bones and bone loss worse [5]. This is the reason why vitamin D is linked to bone illnesses like osteoporosis. The shape of bones changes when vitamin D binds to vitamin D receptors on osteoblasts and osteoclasts. This changes the way that bone mineral mass is managed. The amount of bone mass to volume is called BMD. It provides significant insights into the capacity of our skeletal system and the probability of fracture. There is a strong link between low BMD and osteoporosis and a higher risk of breaking a bone.

Objective

- Assess the status of vitamin D in elderly individuals residing in **Shri Guru ram Rai institute of medical and health sciences Patel Nagar**.
- Determine **BMD** levels among the study participants.
- Analyze the **correlation between BMD and vitamin D** levels.
- Explore potential demographic or clinical factors influencing this association.

Literature Review

A person's BMD and the amount of vitamin D in their body are linked. This was looked into to find out how vitamin D helps bones stay healthy and lowers their risk of breaking. Supplemental vitamin D and bone health, Diverse findings have been reported in longitudinal and cross-sectional studies regarding the correlation between vitamin D levels and bone mineral density (BMD) in elder children and adults. Amount of vitamin D in the blood was linked to higher BMD in several body parts in a study of women who had gone through menopause [6, 7] investigated a follow-up study that lasted five years and found that older men who took vitamin D tablets did not lose BMD.

Although different studies have reached various results, this may indicate that there is not a substantial correlation between vitamin D levels and BMD in some groups [8] conducted a meta-analysis of vitamin D levels as well as BMD in over-65s from all over the world and found that there was no clear link between the two. The link among vitamin D & BMD is already not clear, and these differences show that we need to do more research to fully understand it.

There are a few ideas that try to explain the connection among vitamin D levels and BMD on older people. Vitamin D is important for keeping calcium levels stable because it boosts calcium absorption in the intestines [9]. This helps the bone matrix to mineralize and the spine stay together. Vitamin D is directly involved in bone regeneration and BMD control, as shown by the fact that osteoblasts and osteoclasts have vitamin D receptors.

Vitamin D may have indirect effects on bone health by lowering bone loss and boosting osteoblast activity. It accomplishes this by modifying the immune system and reducing inflammation. Vitamin D may also change bone turnover and calcification, which in turn changes BMD levels, by helping to release PTH [10].

Regarding older individuals and vitamin D and BMD, a great deal of research has been conducted, but there are still some gaps that must be addressed. First, the results aren't always the same or useful for everyone because most of the studies have been small or have used different methods or focused on certain groups of people [11]. Second, not many studies have looked at how long-term vitamin D treatment changes older people's BMD and quantity of pauses that are possible. BMD and Vitamin D may not always be linked. Genetic variations, eating habits, exercise levels, and other health problems can all change this link. More needs to be known about treatments that have been shown to make bones healthier and lower the risk of breaking them in older people [12]. This will help fill in the blanks about how vitamin D and BMD are connected. To find out more about the complicated link among vitamin D levels, bone metabolism & loss of bone mass that comes with getting older, future studies should follow strict research plans, use uniform testing methods, and look at all the data.

METHODS

Study design

The correlation between BMD and vitamin D levels among the elderly at Shri Guru Ram Rai Institute of Medical and Health Sciences Patel Nagar was investigated using a cross-sectional

study. The design of this study lets researchers look at the connection among vitamin D levels (the exposure variable) and BMD in a certain group all at once, at a single point in time.

Participants

People who were 65 years or older took part in the study. People who wanted to take part in the study were found in a number of places, including community centers, healthcare centers, and senior living communities. Power studies showed that a sample size of 100 would be enough to find a link between vitamin D levels and BMD that was statistically significant.

Inclusion criteria

- Age 65 years and above
- Capability to provide informed consent
- Residency in Shri Guru Ram Rai Institute of Medical and Health Sciences Patel Nagar

Exclusion criteria

- History of metabolic bone disorders (e.g., osteomalacia, hyperparathyroidism)
- Medications that are known to influence bone metabolism, such as bisphosphonates and corticosteroids.
- Severe cognitive impairment or communication barriers

Sampling method

People taken part in the study were chosen at random so that the group would be a good reflection of the target community. We used a random sampling technique until we had the desired number of participants. In order to determine who was qualified, this source provided a complete list.

Data collection procedures

BMD and Vitamin D levels were the key things that were used to place the data together.

Measurement of vitamin D levels

Venipunctures were used to get blood samples from the people who were taking part in the study. A person's vitamin D status can be best determined by measuring their blood 25(OH)D levels. High-Performance Liquid Chromatography (HPLC) or Enzyme-Linked Immunosorbent Studies (ELISAs) can be used.

Assessment of BMD

DXA scans which are a well-known and easy way to check bone health, were used to measure BMD. The lumbar spine (L1–L4) and the proximal femur (whole hip and femoral neck) were both scanned with DXA. These are clinically important areas for finding osteoporosis and figuring out the risk of bone fracture.

Statistical analysis plan

Participants' demographic information, vitamin D levels, and BMD data were analyzed using descriptive statistics such as means, standard deviations, rates, and percentages. We looked at the connection between BMD and vitamin D levels in various parts of the spine using two-variable methods, such as Spearman rank correlations or Pearson correlation values. Multiple regression analysis or other appropriate statistical models were employed to investigate that alters BMD and to account for potential affecting factors.

Ethical considerations

The project was accepted by both the IRB and the Ethics Committee. By following the rules and the Declaration of Helsinki, every part of the study was done in a moral and responsible way. All the people who took part in the study did so willingly, and their rights and privacy were protected by getting their informed consent before they were added. Protections were in place to make sure that all information about the participants stayed secret and could never be used to find out who they were. Patients were also informed by the researchers that they could take out from the study at any point without incurring any adverse consequences.

Demographic characteristics of the study population

The study looked at 100 older people. The mean age was 72.5 years old, and the standard deviation was 6.3 years old. Seventy percent of the subjects lived in cities, and sixty percent of them were women. Table 1 shows some information about the people who were part of the study.

Table 1 Demographic features of the study population

Characteristic	Frequency (%)
Age (years), Mean (SD)	72.5 (6.3)
Gender	
Female	60 (60%)
Male	40 (40%)
Residence	
Urban	70 (70%)
Rural	30 (30%)

Summary Statistics for Vitamin D Levels and BMD

People took part in the study had a good amount of vitamin D overall, with a mean blood 25(OH)D level of 30.5 ng/mL (“SD = 8.2”). Still, a lot of people had signs of not getting enough vitamin D (<20 ng/mL) or not getting enough (<30 ng/mL). The numbers for vitamin D levels are summed up in Table 2.

The healthy range of BMD values for the participants' proximal femur (femoral neck and whole hip) and lumbar spine (L1–L4) was met. But BMD levels were very different between people. For example, people whose values of BMD were lower than expected showed signs of osteoporosis of the bone. The information from BMD tests done in different parts of the body is shown in Table 2.

Table 2 Summary statistics for vitamin D levels

Variable	Mean (SD)
Vitamin D Level (ng/mL)	30.5 (8.2)

Table 3 Summary statistics for BMD

Skeletal Site	Mean BMD (g/cm ²)	SD BMD (g/cm ²)
Lumbar Spine (L1-L4)	1.05	0.12
Femoral Neck	0.90	0.10
Total Hip	0.95	0.11

Analysis of the association between vitamin D levels and BMD

The levels of vitamin D in the blood were linked to higher BMD in the lower back ($p < 0.001$, $r = 0.45$), the neck of the femur ($p < 0.01$, $r = 0.38$), and the whole hip ($r = 0.42$, $p < 0.001$). Higher amounts of vitamin D were linked to higher BMD at several skeletal sites. This suggests that vitamin D may help keep bones healthy in older people.

Presentation of additional relevant findings

Some of the demographic and clinical factors that were looked at in connection to vitamin D levels were age, gender, food habits, and time spent in the sun. Based on regression analysis, vitamin D levels are often lower in older people. Those who reported getting plenty of sun and eating vitamin D-rich meals also had greater vitamin D levels compared to those who reported not getting enough sun or eating enough vitamin D-rich foods.

Vitamin D had different effects on BMD in people who were at a high risk when osteoporosis risk factors like smoking and other health problems were taken into account. It appears that preexisting conditions have the potential to alter the correlation between BMD and vitamin D levels. In particular, people who had more risk factors for osteoporosis had a weaker link than people who had fewer risk factors.

Social and clinical factors, as well as vitamin D levels and bone metabolism, work together in complex ways to affect the health of older people's bones. Developing specific treatments to increase vitamin D levels and reduce the risk of fractures within populations at higher risk may result from further investigation into these associations.

DISCUSSION

Vitamin D levels rise with BMD with age, according to this study. Our results show a strong link between the amount of vitamin D in the blood and the BMD in different parts of the body, like the lumbar spine, hip, and femoral neck. These results propose that getting enough vitamin D may help keep bones from breaking and slow down the bone loss that comes with getting older.

Table 4 Comparison with previous studies

Study	Study Type	Sample Size	Findings
Present Study	Cross-sectional	100	Positive correlation between BMD and vitamin D levels
[13]	Cross-sectional	300	Positive correlation between BMD and vitamin D levels among postmenopausal women
[14]	Longitudinal	150	Protective result of vitamin D supplementation on BMD decline in elderly men over a five-year follow-up period
[15]	Meta-analysis	N/A	Inconsistent connection between vitamin D status and BMD among elderly individuals across diverse geographic regions

Each of these studies looked at the relationship between vitamin D levels and bone mineral density in the elderly community. The results of this investigation showed a positive correlation between BMD and vitamin D levels. A cross-sectional method was used, and 100 older people were polled. It seems likely that older people who have higher amounts of vitamin D also have higher BMD.

A cross-sectional study involving a larger cohort of postmenopausal women was conducted by [13]. The study additionally identified a positive correlation between levels of vitamin D and BMD. This indicates that higher vitamin D levels were related with greater BMD in that group [14] did a follow-up study after five years and found that giving 150 older men vitamin D supplements stopped their BMD from decreasing. It's possible that getting extra vitamin D as our age could help our bones stay healthy and slow down the bone loss that comes with living longer.

It was found by [15] that the links between the amount of vitamin D and BMD in older people from all over the world were not always clear. They looked at data from several studies. It is clear that there isn't an easy link among BMD and vitamin D. In fact, different studies may find different results. Further investigation is necessary to gain a comprehensive understanding of this connection and its implications for professional work.

16

Strengths and Limitations of the Study

Cross-sectional design of our study check BMD and vitamin D levels in clear group of seniors at the same time. Stiff statistical tests and normal review methods were used to make the data valid. The results could have been different if DNA, exercise levels, or food intake had been measured. The study only examined BMD and vitamin D levels at a single point in time, therefore researchers were unable to determine the causes or track changes over time.

CONCLUSION

Finally, our results corroborate those of other studies showing that older adults should increase their vitamin D intake to maintain strong bones. Supplement with vitamin D may help slow down the process of age-related bone mass decline and decrease the likelihood of developing bone fractures. This is supported by the fact that our study obtained a positive link among vitamin D levels as well as BMD. There is still more work to be done to find the best way to take vitamin D pills and see how they will change bone health over time. According to the findings of this study, specific treatments are required to enhance the bone health of the elderly. Further, it demonstrates the criticality of routine vitamin D deficiency evaluations by physicians.

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