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Original Research Article

Evaluation of role of vitamin-D levels in osteoporosis

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ABSTRACT

Background: Osteoporosis is a serious, worldwide, and growing health problem; WHO has estimated the 30% of all women, older than 50 years (post-menopausal) has osteoporosis. Osteoporosis is a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture. Bone strength reflects the integration of two main features: bone density and bone quality.
Methods: After clinical examination, patients were subjected to lab and radiological investigation as under: complete hemogram with ESR, serum calcium, phosphate, alkaline phosphatase, parathyroid hormone, 25 (OH) vitamin-D, KFT, LFT, DEXA scan. From above data, vitamin-D levels DEXA scan (t-score) was collected and statistically analysed.
Results: 53 radiologically established cases by DEXA score (spine) of osteoporosis/osteopenia and 50 persons in control group of the age and sex match with normal DEXA score, presenting to OPD of central institute of orthopaedics, VMMC and Safdarjung Hospital were selected. The mean vitamin D3 level in cases was 19.37ng/ml with standard deviation of 10.2. Range of serum vitamin D3 levels in cases was from 7 to 51.2. Whereas mean vitamin D3 level in control group was 25.92 ng/ml with standard deviation of 7.24. Range of serum vitamin D3 levels in controls was from 10 to 35.5. The mean vitamin D levels of cases and control was 19.735±10.2 and 25.92±7.2 ng/ml respectively, these values were compared by using student t test and results were found to be statistically significant (P= 0.0001). The mean T score in spine cases was -2.59 with standard deviation of 0.92. Range of T score in cases was from -5.1 to -1. Whereas, mean T score in control group was -0.26 with standard deviation of 0.68. Range of T score in controls was from -0.9 to 1.4. The mean T score spine of cases and controls was -2.59±0.92 and -0.264±0.68 respectively, these values were compared by using student t test and results were found to be statistically significant (P = 0.0001).
Conclusions: Study recommend that, vitamin D supplementation should be given to patients with osteopenia/osteoporosis. Further prospective studies to firmly establish the relationship between vitamin D and osteoporosis as well as evaluation of vitamin D supplementation in osteoporosis are needed.

Keywords: DEXA, Osteoporosis, Post-menopausal, Vitamin D

INTRODUCTION

Osteoporosis is a serious, worldwide, and growing health problem; the incidence of osteoporotic fracture is gradually increasing mainly in females.[1] WHO has estimated the 30% of all women, older than 50 years (post-menopausal) has osteoporosis. Osteoporosis is a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture.[2] Osteoporosis is an important public health issue in post-menopausal women, and when the condition is left untreated, the women will have increased tendency of fragility fracture during their lifetime.

Fractures, especially of spine, hip and wrist are frequent clinical complications of osteoporosis. Osteoporosis is detected through the measurement of bone mineral density or when a minimal trauma fracture occurs. As osteoporosis has minimal symptoms prior to fracture, it is often under diagnosed and under-treated.[3] Low vitamin-D state and decreased exposure to sunlight contributes to mal-absorption of calcium and vitamin - D insufficiency leading to osteoporosis. Vitamin - D is needed to maintain calcium homeostasis, skeletal integrity and muscle strength.

Low serum 25 (OH)-D concentration is associated with hyper-parathyroidism, increased bone turnover, reduced BMD and increased risk of osteoporotic fracture.[4-6] In addition, administration of vitamin D to the elderly slows bone turnover, increases BMD, and reduce the rate of fragility fractures. Studies done on osteoporotic populations in different geographical areas have demonstrated significant association between vitamin D and its role in osteoporosis.

METHODS

Hospital based prospective study conducted at the Central Institute of Orthopaedics (CIO), Safdarjung Hospital, New Delhi.

Inclusion criteria

All clinically suspected cases of osteopenia and osteoporosis with age >40 years.

Exclusion criteria

- Secondary causes of osteoporosis, patients already taking vitamin-D, mal-absorption syndrome
- Patient having a chronic debilitating illness (cancer, AIDS, CHF, COPD), renal disease, IBD, chronic pancreatitis, small bowel resection. Patient on treatment of Steroid, HRT and anticonvulsant, malignancy, liver disease, psychiatric patients.

After clinical examination, patients were subjected to lab and radiological investigation as under

Complete hemogram with ESR, serum calcium, serum phosphate, alkaline phosphatise, parathyroid hormone, 25 (OH) vitamin-D, kidney and liver function test, DEXA scan.

From above data, vitamin-D levels and dexa scan (t-score) was collected, tabulated and compared by Pearson's correlation coefficient/independent t-square test. The standard curve from which the 25 -OH Vitamin D concentration in patient's serum sample can be taken was obtained by point to point plotting of the extinction values measured for the 6 calibration sera against the corresponding units(linear/log).

RESULTS

53 radiologically established cases by DEXA SCORE (spine) of osteoporosis/osteopenia and 50 persons in the control group of the age and sex match with normal DEXA SCORE, presenting to outpatient Department of central Institute of Orthopaedics, VMMC and Safdarjung Hospital were selected. The mean Vitamin D3 level in cases was 19.37 ng/ml with standard deviation of 10.2. Range of serum Vitamin D3 levels in cases was from 7 to 51.2. Whereas, mean Vitamin D3 level in control group was 25.92 ng/ml with standard deviation of 7.24. Range of serum vitamin D3 levels in controls was from 10 to 35.5.

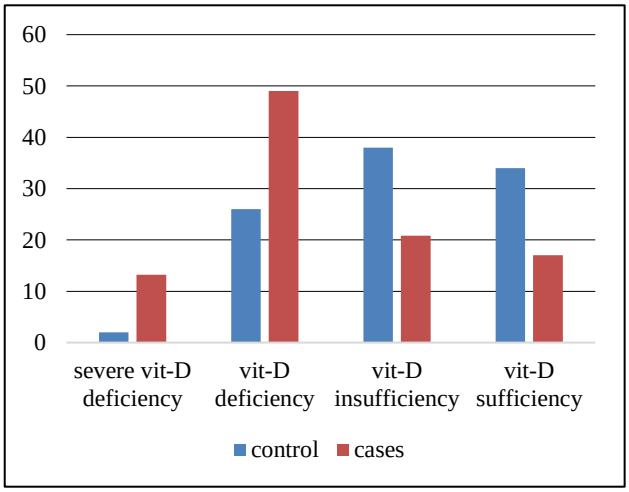

Figure 1: Vitamin D3 status in cases and control.

Vitamin D3 levels

Table 1 shows the mean vitamin D3 level in cases was 19.37 ng/ml with standard deviation of 10.2. Range of serum vitamin D3 levels in cases was from 7 to 51.2. Whereas mean vitamin D3 level in control group was 25.92 ng/ml with standard deviation of 7.24. Range of serum Vitamin D3 levels in controls was from 10 to 35.5.

Table 1: Serum vitamin D3 levels in cases and control.

Serum vitamin D level	No. of patients	Range	Minimum	Maximum	Mean	Standard deviation
Cases	53	44.2	7	51.2	19.37	10.2
Control	50	25.5	10	35.5	25.92	7.24

The mean T score in spine cases was -2.59 with standard deviation of 0.92. Range of T score in cases was from -5.1 to -1. Whereas mean T score in control group was -0.26 with standard deviation of 0.68. Range of T score in controls was from -0.9 to 1.4.

Table 2: Distribution of cases according to vitamin D levels.

	Severe deficiency (<10 ng/ml)		Deficiency (10-20ng/ml)		Insufficiency (20-30 ng/ml)		Sufficiency (>30 ng/ml)	
	Numbers	%	Numbers	%	Numbers	%	Numbers	%
Control (50)	1	2	13	26	19	38	17	34
Cases (53)	7	13.2	26	49	11	20.8	9	17

Table 3: Statistical analysis of vitamin-D and age in cases and control.

	Group	Numbers	Mean	Standard deviation	Standard error mean	P value
Age	Control	50	56.62	8.66	1.22	0.92
	Cases	53	56.45	8.35	1.14	
Vitamin-D	Control	50	25.92	7.24	1.02	0.0001
	Cases	53	19.37	10.21	1.40	

The mean vitamin D levels of cases and control was 19.735±10.2 and 25.92±7.2ng/ml respectively, these values were compared by using student t test and results were found to be statistically significant (P= 0.0001). There is no significant difference between control group and the cases as far as age is concerned, but vitamin D is highly significant (p = 0.0001) between control and cases

Table 4: Statistical analysis of vitamin D status in cases and control.

	Serum vitamin D3		Total	P value
	Deficiency /insufficiency	Optimal		
Cases	44	9	53	
Controls	33	17	50	
Total	77	26	103	0.0001

Vitamin D is highly significant (p = 0.0001) between control and cases. Odds ratio = 2.518. Confidence interval (95%) - lower limit 3.07, upper limit 10.03 P value (0.0001) is lesser than 0.05 suggesting it to be significant. Also, odds ratio calculated comes out to be 2.518 which is more than 1.

T - scores by DEXA scan

The mean T score in spine cases was -2.59 with standard deviation of 0.92. Range of T score in cases was from -5.1 to -1.

Whereas mean T score in control group was -0.26 with standard deviation of 0.68. Range of T score in controls was from -0.9 to 1.4.

Table 5: Statistical analysis of T score of spine in cases and control.

T score	Numbers	Range	Minimum	Maximum	Mean	Std deviation	P values
Cases	53	4	-5.1	-1	-2.59	0.92	0.0001
control	50	2.3	-0.9	1.4	-0.264	-0.68	0.0001

Table 6: Statistical analysis of T score of right femur in cases and control.

T score	N	Range	Minimum	Maximum	Mean	Std deviation	P values
Cases	53	5.4	-5.9	-0.5	-1.86	-0.98	0.0001
Control	50	3.1	-1.8	1.3	-0.25	-0.68	0.0001

The mean T score spine of cases and controls was -2.59±92 and -0.264±68 respectively, these values were compared by using student t test and results were found to be statistically significant (P= 0.0001).

The mean T score RT femur of cases and controls was -1.86±0.98 and -0.25±0.68 respectively, these values were compared by using student t test and results were found to be statistically significant (P=0.0001).

The mean T score LT femur of cases and controls was -1.84±95 and -.27±0.69 respectively, these values were compared by using student t test and results were found to be statistically significant (P=0.0001).

Table 7: Statistical analysis of T score of Left femur in cases and control.

T score	N	Range	Minimum	Maximum	Mean	Std deviation	P value
Cases	53	5.2	-5.6	-0.4	-1.84	0.95	0.0001
Control	50	3.3	-1.9	1.4	-0.27	0.69	0.0001

Out of 53 cases, 23 (43.4%) had osteopenia and 30 (56.6%) had osteoporosis.

There were 23 males cases, 7 had osteopenia and 16 had osteoporosis and in 30 female cases, 16 had osteopenia and 14 had osteoporosis.

DISCUSSION

The present study was conducted in a cohort of 53 radiologically established cases by DEXA

SCORE (spine) of osteoporosis/osteopenia and 50 persons in the control group of the age and sex match with normal DEXA SCORE. We investigated the association amongst prevalent 25 (OH) D levels and BMD in patients with osteopenia and osteoporosis. Several studies have documented hypovitaminosis D in people living in countries with abundant sunshine. Lips P et al conducted study in 2001; A global study of vitamin-D status and parathyroid function in postmenopausal women with osteoporosis: baseline data from the multiple outcomes of raloxifene evaluation clinical trial, on 7564 postmenopausal women and found that serum vitamin D was less than 25 nmol/L in 4% of the women, and this was associated with a 30% higher serum PTH. A low serum 25 (OH) D level was also associated with higher serum ALP and lower BMD of the trochanter. Treatment with vitamin D3 and calcium increased serum 25 (OH) D and decreased serum PTH significantly; the effect was greater for lower baseline serum 25 (OH) D.[7]

Holick et al conducted study, prevalence of vitamin D inadequacy among post-menopausal North-American women receiving osteoporosis therapy. Prevalence of suboptimal 25 (OH) D was significantly higher in subjects who took less than 400 versus 400 IU/d or more vitamin D. There was a significant negative correlation between serum parathyroid concentrations and vitamin D.[8] Batra et al conducted a study of relationship between vitamin D insufficiency in Osteoporosis and blood bone biochemistry on 62 subjects including 31 controls, and found that assays for routinely used bone biochemistry parameters including serum CA, PO4, PTH and ALP are not representative of hypovitaminosis D even in those whose serum PTH is elevated and only best way to confirm this is to do vitamin D levels.[9] Paul T et al conducted study, prevalence of osteoporosis in ambulatory post-menopausal women a semi-urban region in southern India: relationship to calcium nutrition and vitamin-D status on 150 ambulatory postmenopausal women and found that The high prevalence of osteoporosis and vitamin D insufficiency in this semi-urban group of post -menopausal women in India is a major health problem.[10]

Kuchuk et al conducted study, relationships of serum 25-Hydroxyvitamin D to BMD and serum PTH and markers of bone turnover in old persons on 1319 subjects. All BMD values were higher in the higher serum 25 OH D groups, although only significantly for total hip and total body mineral content. A threshold of about 40 nmol/lit existed for osteocalcin and deoxypyridinoline/creatinine, 50 nmol/lit for BMD, and 60 nmol/lit for physical performance.[11]

Melhus et al conducted study, plasma 25-hydroxyvitamin-D level and fracture risk in a community-based cohort of elderly men in Sweden on 1194 person and found 309 of the participants (26%) sustained a fracture. 25 (OH) D levels below 40 nmol/liter, which corresponded to the fifth percentile of 25 (OH) D, were associated with a modestly increased risk for fracture. No risk difference was detected above this level. Approximately 3% of the fractures were attributable to low 25 (OH) D levels in this population.[12] In this study the mean vitamin D3 level in cases was 19.37 ng/ml with standard deviation of 10.2. Range of serum vitamin D3 levels in cases was from 7 to 51.2. Whereas mean vitamin D3 level in control group was 25.92 ng/ml with standard deviation of 7.24. Range of serum vitamin D3 levels in controls was from 10 to 35.5.

Two thirds of the individuals in both case and control groups had 25-hydroxycholecalciferol concentrations less than 30 ng/ml. In our study 62.2% cases and 28% control had 25-hydroxycholecalciferol concentrations less 20 ng/ml. Overall 82% of cases and 66% of control had insufficient or deficient vitamin D status. Among cases, 9 had vitamin D sufficiency (>30 mg/ml), 11 had vitamin D

insufficient (20-30 mg/ml), 26 had vitamin D deficiency (10-20 mg/ml) and 7 had severe vitamin D deficiency (<10 mg/ml) and among controls, 17 had vitamin D sufficiency (>30 mg/ml), 19 had vitamin D insufficient (20-30 mg/ml), 13 had vitamin D deficiency (10-20 mg/ml), and had vitamin D deficiency (10-20 mg/ml) and 1 had severe vitamin D deficiency.

Mean 25-hydroxycholecalciferol concentrations were low in all participants (< 30 ng/ml), although significantly lower in patients with osteoporosis/osteopenia (p value = 0.0001, odds ratio = 2.518). Positive correlation seen in our study consistent with study conducted in north India by Vupputuri MR et al, who concluded significant relation between serum 25 (OH) D concentrations and hip BMD but not with lumbar spine or forearm BMD in an urban Delhi cohort. But in present study the correlation of vitamin D3 is also significant with BMD of lumbar vertebra (L1-L4).[13]

In cross-sectional studies on 330 elderly women in Amsterdam, a positive relationship has been observed between serum 25 (OH) D and bone mineral density (BMD) of the hip. The positive correlation was significant when serum 25 (OH) D was lower than 30 nmol/ltr, but above this level the relation was not significant.[14] A positive relationship between serum 25 (OH) D and BMD of the hip has been observed in middle aged women in the United Kingdom (4-65 year) and in old women in New Zealand. Similarly, a negative relationship has been observed between BMD of the hip and serum PTH.[14] Another interpretation of the association between low serum 25 (OH) D and low BMD is a sedentary life style having reduced exposure to sunlight. This would cause bone loss due to immobility. However, immobility is associated with increased bone resorption, which causes decline of parathyroid activity and a low serum PTH.[14] Some studies have reported a positive relation between 25 (OH) D levels and measured BMD at all sites. Others have found a relation at the femoral neck but not at other sites.[15] Study conducted in southeast Asia having patients with low BMD concluded no association between 25(OH)D levels and BMD at the femoral neck, hip, and lumber spine.[16] In present study, no relationship was found between BMD with age and sex.

Limitation of this study sample size was small, therefore larger sample size additional studies will further validate our findings.

CONCLUSION

Osteoporosis being a preventable condition, early prophylactic measures in the form of vitamin D may be helpful for preventing osteopenia/osteoporosis and future fracture risk. Study recommend that, vitamin D supplementation should be given to patients with osteopenia/osteoporosis.

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Ethical approval: The study was approved by the institutional ethics committee

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