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# Vitamin D Status in Post-Menopausal Female Including Post-Menopausal Osteoporosis and Prevalence of Hypovitaminosis-D

M.F Alam[1], M.S Alam[2*], K Baruah[3]

[1]Assistant Professor, Department of Medicine, Katihar Medical College, Katihar, Bihar, India
[2]Assistant Professor, Department of Orthopaedics, Katihar Medical College, Katihar, Bihar, India
[3]Professor, Department of Medicine, Katihar Medical College, Katihar, Bihar, India

***Corresponding author:** M.S Alam
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**Abstract** **Original Research Article**

Context: Vitamin D status plays an important role in mineralisation of the skeleton at all ages. An alteration in vitamin D status and/or a reduced synthesis of 1, 25-dihydroxy vitamin D predispose to secondary hyperparathyroidism, which enhances bone remodelling and causes cortical bone loss. Aims: The present study was designed to evaluate: the prevalence of hypovitaminosis D in post-menopausal females and Relationship between vitamin D status in postmenopausal females with osteoporosis and without osteoporosis. Materials and methods: One hundred and forty-six post-menopausal women between 45 to 75 years attending the hospital OPD were studied. To be eligible for the study they had to have been post-menopausal for at least one year. The diagnosis of osteoporosis was made based on T-scores (BMD) at the lumbar spine (L1 to L4) and femoral neck by DEXA (GE Lunar Densitometer). Patients with chronic conditions affecting skeletal health and patients on drugs affecting the skeleton were excluded from the study. Serum 25(OH) vitamin D was estimated using LIAISON 25 OH Vitamin-D chemiluminescent immunoassay. Results: Out of 146 post-menopausal females, 100 subjects had vitamin D deficiency (≤ 20 ng/ml) and 29 subjects had vitamin D insufficiency (21 - 29 ng/ml). Thus, prevalence of hypovitaminosis D in post-menopausal females was 88.35%. Serum vitamin D was found to be significantly lower in post-menopausal women with osteoporosis as compared to post-menopausal women without osteoporosis ($p< 0.05$). On correlation analysis a positive correlation was noted between BMD and vitamin D, it was statistically significant. Conclusion: Serum vitamin D is a promising marker of bone turnover in post-menopausal women with osteoporosis, as it was found to be decreased in osteoporosis; therefore, it provides a dynamic measure of bone remodelling and it can be potentially useful in diagnosis and monitoring of response to therapy in patients of osteoporosis.

**Keywords:** Vitamin D, mineralisation, hypovitaminosis, osteoporosis.

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## INTRODUCTION

A lack of estrogen in postmenopausal women prevents the absorption and utilization of calcium and is the single most important factor in the development of osteoporosis [1].

Osteoporosis has a tremendous impact on the lives of many postmenopausal women. Fractures are potentially devastating complications of osteoporosis. Also, the number of osteoporotic fractures is increasing as the population ages, and assessment of skeletal health is becoming an important component of a woman's routine care [2]. Worldwide the life-time risk for women to have osteoporotic fracture is 30-40% [3]. Occurrence of osteoporosis is 10 years earlier in Indian people than in the West. It currently affects approximately one in three women and one in five men over age 50[2]. Nutrition is a critical component in the pathogenesis, prevention, and treatment of osteoporosis [4]. Among nutrients, calcium and vitamin D play an important role in the mineralisation of the skeleton at all ages, an alteration in vitamin D status and/or a reduced synthesis of 1, 25-dihydroxy vitamin D predispose to secondary hyperparathyroidism, which enhances bone remodelling and causes cortical bone loss [5]. Although present in food, the major source of vitamin D is synthesized in skin after exposure to sunlight. Variety of factors influence cutaneous production of Vitamin D. such as aging, melanin content of skin ,geographical location, seasons, and level of clothing and use of sunscreens[6,7].

The present study was designed to evaluate: the prevalence of hypovitaminosis D in post-menopausal females, Relationship between vitamin D

status in postmenopausal females with osteoporosis and without osteoporosis.

## MATERIALS AND METHODS

The present study was conducted at the Department of Medicine and Department of orthopaedics, Rohilkhand Medical College and Hospital, Rohilkhand University, Bareilly, UP. One hundred and forty-six post-menopausal women between 45 to 75 years attending the hospital OPD were studied. To be eligible for the study they had to have been postmenopausal for at least one year.

Out of 146 post-menopausal women 72 had osteoporosis (according to the above mentioned definition). These 72 females also included 16 patients presenting to the emergency/orthopaedic department with fragility fracture. A fragility fracture was defined as one that occurred as a result of minimal trauma, such as a fall from a standing height or less, or occurred without identifiable trauma. Rest of 74 post-menopausal women were without osteoporosis.

Exclusion criteria for the study were oestrogen replacement therapy within 1 year, deranged renal function (serum creatinine >1.5 mg %) or renal calculi, abnormal thyroid function, significant liver disease, history of cancer, peptic ulcer, or oesophageal disease requiring prescription. Regular therapy with phosphate binding antacid, therapy with any other drug that affects the skeleton, e.g. steroids, anti-resorptive therapy, anticonvulsant, anticoagulants, etc. Informed consent was obtained from all the subjects participating in the study; and the study was approved by the local ethical committee. A detailed history and physical examination was carried out for every subject who entered in the study as per a pre-designed Performa. Examination comprised of a thorough physical examination, assessment of vital parameters, anthropometry and systemic examination. Bone mineral density (BMD) was measured using DEXA by GE Lunar Densitometer. Serum 25 (OH) vitamin D was estimated using LIAISON 25 OH vitamin D chemiluminescent immunoassay. vitamin D sufficiency was defined as serum 25 (OH) vitamin D in the range of 30 to 100 ng/ml, vitamin D insufficiency as values between 21 - 29 ng/ml, and values $\leq$ 20 ng/ml were defined as vitamin D deficiency. Statistical analysis was performed using SPSS version 16 statistical package for windows (SPSS, Chicago, IL).

## OBSERVATIONS

The baseline characteristics of 146 post-menopausal women are shown in Table I. The mean age of post-menopausal females without osteoporosis was 51 ± 3.88 years and post-menopausal with osteoporosis was 56.57 ± 8.15 yrs. Similarly, mean duration of menopause in post-menopausal females without osteoporosis group was 3.85 ± 1.82 and in postmenopausal females with osteoporosis group was 9.56 ± 5.80 suggesting significant difference in the two groups. There was a significant difference in the BMD lumbar spine in the two groups ($p < 0.05$). BMD lumbar spine was 1.20 ± 0.18 in the post-menopausal women without osteoporosis group as compared to 0.81 ± 0.13 in the osteoporosis group. Similarly there was significant difference in the BMD hip in the two groups ($p < 0.05$).

Mean T- score at lumbar spine was 1.41 ± 0.29 and -3.14 ± 1.0 in post-menopausal women without osteoporosis and with osteoporosis respectively, suggesting a significant difference in the two groups ($p < 0.05$). Similarly, there was significant difference in the mean T-score at hip ($p < 0.05$).

Out of 146 post-menopausal females, 100 subjects had vitamin D deficiency ($\leq$ 20 ng/ml) and 29 subjects had vitamin D insufficiency (21-29 ng/ml). Thus, prevalence of hypovitaminosis D in post-menopausal females was (88.35%). Out of seventy--two post-menopausal female with osteoporosis, fifty-five (77.33%) had vitamin D deficiency ($\leq$ 20 ng/ml), eleven (16.0%) had vitamin D insufficiency (21-30 ng/ml), and only six females (5.40%) had vitamin D in the normal range (30 - 100 ng/ml). Out of seventy-four post-menopausal females without osteoporosis group, forty-five (58.90%) had vitamin D deficiency ($\leq$ 20 ng/ml), eighteen (24.65%) had vitamin D insufficiency (21 - 30 ng/ml) and eleven females (15.27%) had vitamin D in the normal range (30-100 ng/ml). So, prevalence of vitamin D deficiency and insufficiency was 68.49% and 19.86% respectively in post-menopausal females.

Serum vitamin D was found to be significantly lower in post-menopausal women with osteoporosis as compared to post-menopausal women without osteoporosis ($p < 0.05$), mean serum vitamin D was 15.22 ± 6.23 ng/ml in osteoporosis group as compared to 19.51 ±8.58 ng/ml in the other group. Whole blood ionised calcium was 1.16 ±0.10 mmol/l and 1.07 ± 0.09 mmol/l in post-menopausal women without osteoporosis and with osteoporosis respectively, suggesting a significant difference between the two groups. On correlation analysis a positive correlation was noted between BMD and vitamin D, it was statistically significant ($r 2 = 0.201$, $p < 0.05$).

On comparing impact of duration of menopause on BMD and serum vitamin D levels, patients with < 10 years of menopause had mean BMD at spine 0.86 ± 0.13 g/cm$^2$, mean BMD at hip 0.86 ± 0.15 g/cm$^2$ and mean serum vitamin D 15.42 ± 6.30 ng/ml, while patients with > 10 yrs of menopause had mean BMD at spine 0.75 ± 0.11 g/ cm$^2$, mean BMD at hip 0.75 ± 0.13 g/cm$^2$and mean serum vitamin D 15.02 ±6.16 ng/ml. On applying paired t-test there was significant difference in the two groups in terms of

mean BMD, as well as mean serum vitamin D levels (Table II).

**Table-I: Showing baseline characteristics of study subjects**

| S. No. | Parameter | Post-menopausal without osteoporosis | | Post-menopausal with osteoporosis | | P value |
|---|---|---|---|---|---|---|
| | | N = 74 | | | N = 72 | |
| | | Mean | S.D | Mean | S.D | |
| 1 | Age (years) | 51 | 3.88 | 56.57 | 8.15 | < 0.05 |
| 2 | Time since menopause (years) | 3.85 | 1.82 | 9.56 | 5.80 | < 0.05 |
| 3 | BMI (kg/m²) | 26.61 | 4.12 | 25.73 | 5.72 | NS |
| 4 | BMD - lumbar spine (g/cm²) | 1.20 | 0.18 | 0.81 | 0.13 | < 0.05 |
| 5 | T. score - lumbar spine | 1.41 | 0.29 | -3.14 | 1.10 | < 0.05 |
| 6 | BMD - hip (g/cm²) | 1.22 | 0.15 | 0.81 | 0.15 | < 0.05 |
| 7 | T. score – Hip | 1.34 | 0.26 | -1.87 | 1.03 | < 0.05 |
| 8 | Whole blood ionised calcium (mmol/l) | 1.16 | 0.10 | 1.07 | 0.09 | < 0.05 |
| 9 | Serum 25 (OH) vit D (ng/ml) | 19.51 | 8.58 | 15.22 | 6.23 | < 0.05 |
| | Deficiency (≤ 20 ng/ml) | 13.64 | 3.87 | 12.49 | 3.12 | <0.06 |
| | Insufficiency (21 - 29 ng/ml) | 23.56 | 2.77 | 21.78 | 1.71 | < 0.05 |
| | Normal (30 - 100 ng/ml) | 34.49 | 2.63 | 31.34 | 1.66 | < 0.05 |
| 10 | S. TSH (mIU/l) | 2.90 | 1.23 | 2.65 | 2.05 | NS |
| 11 | S. creatinine (mg/dl) | 1.14 | 0.19 | 0.95 | 0.16 | < 0.05 |

**Table-II: Impact of duration of menopause on BMD and Serum 25 (OH) vit D (ng/ml)**

| S. No. | Parameter | Patients with < 10 years of menopause | | | Patients with ≥ 10 years of menopause | | | P value |
|---|---|---|---|---|---|---|---|---|
| | | | N = 38 | | | N = 35 | | |
| | | Mean | | S.D | Mean | | S.D | |
| 1 | BMD (spine) (g/cm²) | 0.86 | | 0.13 | 0.75 | | 0.11 | < 0.05 |
| 2 | T. score (spine) | -2.73 | | 1.08 | -3.59 | | 0.96 | < 0.05 |
| 3 | BMD (hip) (g/cm²) | 0.86 | | 0.15 | 0.75 | | 0.13 | < 0.05 |
| 4 | T. score hip | -1.52 | | 0.85 | -2.25 | | 1.09 | < 0.05 |
| 5 | Serum 25 (OH) vit D (ng/ml) | 15.42 | | 6.30 | 15.02 | | 6.16 | < 0.05 |

## DISCUSSION

The present study was carried out with the aims to determine the prevalence of hypovitaminosis D in postmenopausal women, significance of serum vitamin D in evaluation of osteoporosis, Relationship between vitamin D status in postmenopausal females with osteoporosis and without osteoporosis.

Normal bone metabolism depends on the presence of appropriate repletion of vitamin D. Although only few patients with osteoporosis exhibit obvious biochemical signs of hypovitaminosis D, vitamin D insufficiency has been shown to have adverse effects on calcium metabolism, osteoblastic activity, matrix ossification, bone mineral density (BMD), and bone remodelling[8]. Low serum 25 (OH) vitamin D concentration is associated with secondary hyperparathyroidism, increased bone turnover, reduced BMD, and increased risk of osteoporotic fractures [9]. In our study, we found that majority of the subjects had hypovitaminosis D. Out of seventy--two post-menopausal female with osteoporosis, fifty-five (77.33%) had vitamin D deficiency (≤ 20 ng/ml), eleven (16.0%) had vitamin D insufficiency (21 - 30 ng/ml), and only six females (5.40%) had vitamin D in the normal range (30 - 100 ng/ml). Out of seventy-four post-menopausal females without osteoporosis group, forty-five (58.90%) had vitamin D deficiency (≤ 20 ng/ml), eighteen (24.65%) had vitamin D insufficiency (21 - 30 ng/ml) and eleven females (15.27%) had vitamin D in the normal range (30 - 100 ng/ml). So, prevalence of vitamin D deficiency and insufficiency was 68.14% and 20.21% respectively in post-menopausal females.

So, prevalence of vitamin D deficiency and insufficiency was 68.49% and 19.86% respectively in post-menopausal females. The overall prevalence of hypovitaminosis D was 88.35%. Prevalence of hypovitaminosis D in post-menopausal women was found to be 47% in Thailand, 49% in Malaysia, 90% in Japan, and 92% in South Korea [10]. Harinarayan *et al.* reported vitamin D deficiency in 70% females and insufficiency in 23% females in their study from South India in 2011[11]. Goswami *et al* found hypovitaminosis D was present in up to 90 per cent of apparently healthy subjects in Delhi [12]. Skin complexion, poor sun exposure, vegetarian food habits, low milk intake, high phytates in food, and lack of vitamin D food fortification programme explain the

high prevalence of vitamin D deficiency in India despite its sunny climate.

In the present study, Serum vitamin D was found to be significantly lower in post-menopausal women with osteoporosis as compared to post-menopausal women without osteoporosis ($p < 0.05$), mean serum vitamin D was 15.22 ± 6.23 ng/ml in osteoporosis group as compared to 19.51 ±8.58 ng/ml in the other group. Our study showed a positive correlation between vitamin D and BMD, and the relation was statistically significant ($r2 = 0.201$, $p < 0.05$). Thus, in osteoporosis, low level of vitamin D is seen. Kuchuk *et al.* studied on 7,441 post-menopausal

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