

Correlation of Vitamin D, Parathyroid Hormone and Bone Mineral Density in Pre and Post-Menopausal Females

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Abstract**Original Research Article**

The active form of Vitamin D has endocrine effects on bone as established by its crucial requirement in bone mineralization. Deficiency causes rickets in children, Osteomalacia or Osteoporosis in adults. Low Vitamin D status has been detected in patients with hip fractures. Vitamin D, along with Parathyroid hormone affects bone mineralization. Our study is aimed at correlating the relationship between 25- hydroxyvitamin D, Parathyroid hormone (PTH) and bone mineral density (BMD) in cohort of South Indian population. The Bone mineral density of 60 pre-menopausal and 60 post-menopausal women was compared with Vitamin D and Parathyroid hormone status. BMD of hip and spine were derived from dual energy X-ray absorptiometry. Vitamin D and Parathyroid hormone were assayed by Electro chemiluminescent methodology. Multivariate regression models were employed to investigate the relation between Bone mineral density with Vitamin D and Parathyroid hormone. The average age of pre- menopausal and post-menopausal women is 39 ± 8 years & 57 ± 7 years respectively. The mean values of serum Vitamin D and PTH among premenopausal women were 19 ± 9 ng/mL and 47 ± 18 pg/mL respectively. And the mean value of serum Vitamin D and PTH among post-menopausal women were 19 ± 11 ng/mL and 49 ± 16 pg/mL respectively. Among the post- menopausal women 25 were osteopenic and 31 were osteoporotic whereas among the pre- menopausal women 25 were osteopenic and 10 were osteoporotic. There exist a negative correlation between Vitamin D and Parathyroid hormone, positive correlation between Vitamin D and Bone mineral density and negative correlation between Parathyroid hormone and Bone mineral density. Parathyroid hormone showed a significant negative correlation with Bone Mineral Density at hip and lumbar spine. This signifies the critical role of Parathyroid hormone in maintaining normal bone mineralization.

Keywords: Vitamin D, Parathyroid hormone, Bone Mineral Density, Osteoporosis, Osteopenia, Electrochemiluminescence.

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INTRODUCTION

The active form of Vitamin D has crucial role in calcium homeostasis, functioning as a hormone with autocrine and paracrine effects [1]. Vitamin D, through interaction with Vitamin D receptor (VDR) is responsible for active reabsorption of calcium from intestinal epithelium [2]. Out of the total requirement of Vitamin D more than 90% is synthesized by our body. The action of Ultraviolet B rays on skin convert 7-dehydrocholesterol to cholecalciferol (Vitamin D₃). Cholecalciferol is then hydroxylated in liver to 25-hydroxycholecalciferol, which is the storage form of Vitamin D and considered the best indicator of Vitamin D status in our body. In kidney, 25(OH) D is further hydroxylated to 1, 25(OH)₂ D, the biologically active form of Vitamin D. Vitamin D can also be taken from

diet. Fish oils and Dairy products fortified with Vitamin D are the rich sources of the Vitamin [3].

Apart from the maintenance of Calcium homeostasis, Vitamin D is also necessary for regulation of multiple cellular functions, Immune regulation, functioning of cardiovascular system and interplay of many hormones [4].

The major causes of Vitamin D deficiency include dietary deficiency, malabsorption, decreased exposure to Sun, Prolonged use of anticonvulsants and Corticosteroids [5]. Severe Vitamin D deficiency in adult's results in defective mineralization of osteoid, causing Osteomalacia. Deficiency of Vitamin D ends up in lower serum calcium concentration owing to

defective reabsorption from the intestinal epithelium. This in turn results in secondary hyperparathyroidism as body normally reacts to hypocalcemia by increasing the secretion of from Parathyroid gland [6]. The increased Parathyroid hormone concentration especially in elderly individuals results in increased bone turnover, defective mineralization ultimately resulting in increased risk of fractures. Studies point to the fact that not all patients with hypovitaminosis D ultimately land up in secondary hyperparathyroidism [7, 8]. Low Vitamin D concentration by virtue of the secondary hyperparathyroidism is the contributing factor to low Bone Mineral Density.

Dual energy X-ray absorptiometry (DEXA), estimating the bone mineral density is the standard approach in diagnosing Osteoporosis. The current study aims at assessing the correlation between Vitamin D, Parathyroid Hormone and Bone Mineral Density among Pre and Post-Menopausal Indian females.

MATERIALS & METHODS

Among the normal individuals attending Tamil Nadu Government Multi Super Speciality Hospital, Amma Master Health Check Up, 60 pre-Menopausal and 60 post-Menopausal women were selected for the study. Vitamin D and Parathyroid Hormone were assayed in Automated Immunoanalyzer using electrochemiluminescence technology. Bone Mineral Density was determined at dual anatomical sites: hip and lumbar spine.

The reference values for Vitamin D as determined by the clinical laboratory are as follows: <20 ng/mL (deficiency), 20–29 ng/mL (insufficiency), 30–100 ng/mL (sufficiency), and >100 ng/mL (increased). Parathyroid hormone has reference values range from 16 to 65 pg/mL. Data were expressed as mean, standard deviation and correlation being calculated.

RESULTS

Among the 60 Pre-menopausal women selected for the study, the results for Vitamin D shows a mean of 19 ± 9 ng/mL and the mean PTH value is 47 ± 18 pg/mL. The mean Bone Mineral Density is 0.8 ± 0.12 . Among the 60 Post-menopausal women selected for the study, the results for Vitamin D shows a mean of 19 ± 11 ng/mL and the mean PTH value is 49 ± 16 pg/mL. The mean Bone Mineral Density is 0.38 ± 0.14 .

There exist a negative correlation between Vitamin D and Parathyroid hormone for both pre-menopausal (-0.370) and Post-Menopausal women (-0.380). Similarly there exist a negative correlation between Parathyroid Hormone levels and Bone Mineral density for both Pre-Menopausal (-0.15) and Post-Menopausal (-0.31) women

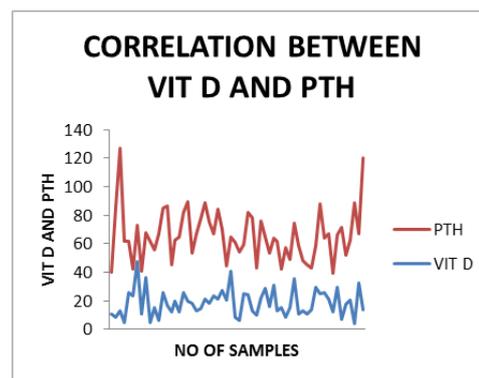


Fig-1: Correlation between vit d and pth in pre-menopausal women

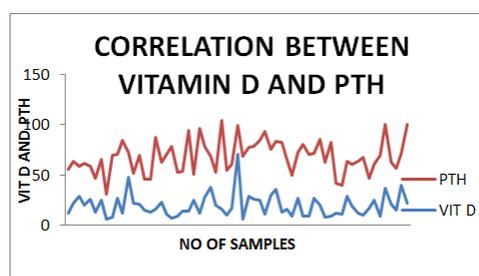


Fig-2: Correlation between vit d and pth in post-menopausal women

There exist a positive correlation between Vitamin D and Bone mineral density for both pre-menopausal (+0.10) and post-menopausal women (+0.09).

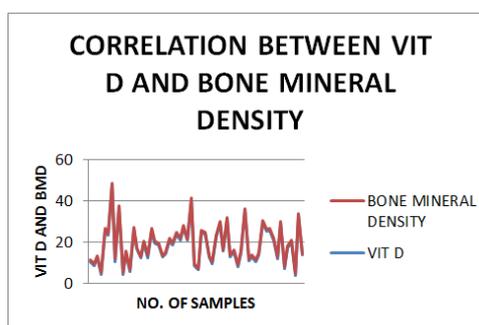


Fig-3: Correlation between vit d and bmd in pre-menopausal women

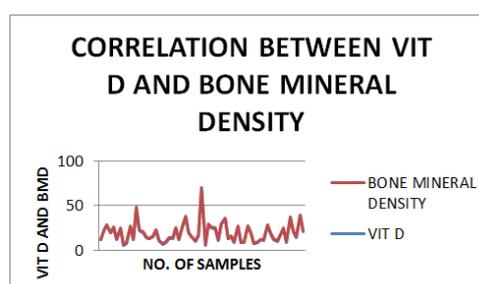


Fig-4: Correlation between vit d and bmd in post-menopausal women

DISCUSSION

The current study investigated the correlation between the levels of Vitamin D and Parathyroid Hormone in serum and corresponding Bone Mineral Density among Pre and Post-Menopausal women. Several studies have well documented the prevalence of Vitamin D deficiency in Tropical countries with abundant exposure to Sunlight [9-11]. The etiology includes Genetic factors, dietary deficiency of Vitamin D and inadequate exposure to Sunlight. Vitamin D deficiency in India has prevalence in alarmingly high rate [12]. Studies in South India have reported Vitamin D deficiency to be as high as 76% in Premenopausal and 70% in Post-Menopausal women [13]. Marwaha *et al.* [14] studied the status of Vitamin D among elderly healthy North Indian Population. He reported the Prevalence of Vitamin D deficiency among the age group is 91.2% and insufficiency among 6.8% of individuals. In our study, the prevalence of Vitamin D deficiency is around 66% among Pre-Menopausal and 70% among Post-Menopausal women.

The deficiency of Vitamin D is gaining importance recently owing to the fact that hypovitaminosis D directly has been linked to several infectious and non-infectious illnesses [15, 16]. Several studies points to lower average Bone Mineral Density among Asian Population [15-17]. The rate of Osteoporotic fractures in urbanized Asian countries roughly equal the Caucasian Populations [18]. Vitamin D deficiency is a risk factor for Osteoporosis. Several studies have reported the existence of positive correlation between Vitamin D levels and Bone Mineral Density at both lumbar spine and hip [19]. Other studies have reported positive correlation, only at the level of femur neck [20, 21]. A similar study from South East Asia conducted in patients with low Bone Mineral Density detected no association Vitamin D and Bone Mineral Density [22]. The current study detects a positive correlation between Vitamin D and Bone Mineral Density. Population based studies points to differing relationship between serum Vitamin D concentrations and Bone Mineral Density in Black and White races [23-25].

Bone Mineral Density declines in elderly age group owing to age related bone loss. In comparison to women of comparable age group, men have higher BMD [26, 27].

Studies have shown the suppression of Parathyroid Hormone at serum Vitamin D levels around 30ng/mL, with inverse relation between Vitamin D and Parathyroid Hormone at serum concentrations below 30 ng/mL [28]. Secondary hyperparathyroidism is principle mechanism contributing to Osteoporosis. The elevation in levels of PTH results in increased bone turn-over and ultimately increased bone loss. Nevertheless, not every patient with Vitamin D deficiency develops secondary hyperparathyroidism. In

such patients with blunted Parathyroid hormone response, hypovitaminosis D results in low serum Calcium concentration. There is reduced bone turnover and protection of Bone Mineral Density in comparison to the individuals with lower serum Vitamin D level coupled to secondary hyperparathyroidism [29]. Our study observed a significant negative correlation between PTH and BMD, leading to the suggestion that secondary hyperparathyroidism is the powerful mediator for bone loss in Vitamin D deficiency.

CONCLUSION

The current study observes a negative correlation between Vitamin D and Parathyroid hormone, positive correlation between Vitamin D and Bone mineral density and negative correlation between Parathyroid hormone and Bone mineral density. Parathyroid hormone showed a significant negative correlation with Bone Mineral Density at hip and lumbar spine. The relationship between PTH and BMD is stronger compared to the relation between Vitamin D and BMD. This signifies the critical role of Parathyroid hormone in maintaining normal bone mineralization.

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