

High Prevalence of Vitamin D Deficiency among North Indian Athletes

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Abstract

Background: Vitamin D deficiency is high in athletes and has an impact on athletes' performance. **Introduction:** Assessment of serum Vitamin D levels in healthy North Indian sportspersons and its correlation with serum parathyroid hormone (PTH) levels and bone mineral density (BMD). **Materials and Methods:** Three-hundred and sixty-nine healthy athletes' aged 18–45 years were enrolled. Depending upon Vitamin D levels athletes were categorized into three groups: deficient (<20 ng/ml), insufficient (20–30 ng/ml), and sufficient (>30 ng/ml). BMD and serum PTH levels were assessed in all athletes and correlation was seen with Vitamin D levels. **Results:** Two-hundred and fifty-eight (69.9%) athletes were Vitamin D deficient, 51/369 (13.8%) were Vitamin D insufficient, and 60/369 (16.3%) athletes were Vitamin D sufficient. There was a direct correlation between low serum Vitamin D levels and low BMD ($r = 0.473$; $P < 0.05$). Overall, 114/369 (30%) athletes had low BMD and out of these 114 athletes, 108 (95%) were Vitamin D deficient. Serum PTH levels were found to have inverse relations with both Vitamin D ($r = -0.629$) and BMD ($r = -0.267$). **Conclusions:** Vitamin D deficiency is highly prevalent among the North Indian athletes and the presence of low Vitamin D (<20 ng/ml) levels is associated with low BMD and high PTH levels.

Keywords: Bone mineral density, parathyroid hormone, Vitamin D

INTRODUCTION

Serum Vitamin D levels have an impact on athletes' performance; therefore, it is important to maintain their normal levels. North India is considered as the hub of athletes and the presence of such a high number of Vitamin D deficiencies among North Indian athletes is alarming. Vitamin D deficiency not only increased the risk of pathological fracture but also increases the risk of multiple other diseases such as coronary artery disease,^[1] inflammatory arthritis,^[2] liver disease,^[3] and bowel disease^[4]. Therefore, it is become important to diagnose Vitamin D deficiency at an early age and treat them pragmatically. There is a need to create awareness among people regarding Vitamin D deficiency. Treatment of Vitamin D deficiency at the community level by fortification of food is the need of the hour.

Despite ample sunshine in India, 70%–100% of healthy adults were reported to be Vitamin D deficient or insufficient.^[5] Goswami *et al.* reported that even healthy young soldiers with sufficient intake of calcium, adequate sun exposure, and regular exercise regimen were found to be Vitamin D

deficient.^[6] Similar findings were also reported by Marwaha *et al.* in young sportspersons.^[7] The International Osteoporosis Foundation reported that 91% of teenage girls and 78% of the hospital staff were Vitamin D deficient.^[8] The reference scale of Vitamin D has been taken from Western standards according to which < 50 nmol/L (<20 ng/ml) is considered as Vitamin D deficiency, 50–75 nmol/L (20–30 ng/ml) is considered as Vitamin D insufficiency and > 75 nmol/L (>30 ng/ml) is considered to be Vitamin D sufficient.^[9] Based on these standards, most of the individuals in India have been reported to be Vitamin D insufficient.^[5] But whether the deficiency as reported in various above studies is an actual deficiency or an overestimation of deficiency due to the use of Western standards of normalcy needs to be studied. Hence, the present

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study was designed to see the correlation of Vitamin D levels with bone mineral density (BMD) and serum parathyroid hormone (PTH) levels. Another aim of this study was to see the amount of Vitamin D deficiency among North Indian athletes based on Western standards.

MATERIALS AND METHODS

This study was conducted from 2017 to 2019, after getting institutional ethical committee approval. Professional and recreational athletes who visited sports clinics in our institute and meeting inclusion/exclusion criteria were enrolled for the study. Informed and written consent was obtained from all the patients. Based upon 70%–100% deficiency of Vitamin D in ostensibly healthy individuals,^[5] the optimum sample size was calculated. After assuming the confidence level to be 95%, permissible error 5%, and sampling error 10%, the optimum sample size came out to be 369. Inclusion criteria were athletes of both genders involved in outdoor games, age of 18–40 years who had no comorbidities (American Society of Anesthesiologists – Grade 1) and did not consume Vitamin D supplementation in the past 6 months. Exclusion criteria were the presence of liver disease/renal disease/gastrointestinal disease/metabolic bone disease, suffering from skin disease affecting melanin pigmentation, and taking steroids/ketoconazole/antiretroviral drugs.

Blood samples were received in a plain vial. The blood parameters: serum calcium, serum phosphorus, liver function tests, renal function tests, and serum alkaline phosphatase were analyzed on Automated Chemistry Analyser (Modular P-800); and serum 25-hydroxyvitamin D and PTH levels were analyzed on chemiluminescence analyzer Advia Centaur-XP. Bone quality was checked by DEXA scan. The results of the DEXA test were reported as a “Z-score.” DEXA scan was done on Hologic QDR 4500 Discovery A/SL/W/C. A Z-score of -1 or above indicates normal BMD. A Z-score of -1 to -2.5 indicates osteopenia. A Z-score of <-2.5 indicates osteoporosis. The scan was done for the spine and hip. Healthy individuals were represented by athletes having normal serum calcium, serum phosphorus, serum alkaline phosphatase, normal renal, and liver function tests. Data were recorded in a predesigned format for comparison. Athletes were divided into three groups depending upon the serum Vitamin D levels -Vitamin D deficient (<20 ng/ml), insufficient (20–30 ng), and sufficient (>30 ng/ml).

Statistical analysis

Continuous and normally distributed data were described in the form of its mean and standard deviation. Association between bone quality parameters and Vitamin D levels was assessed by using the Chi-square test of significance. Skewed data were written in the form of its median and interquartile range. Correlation between Vitamin D versus BMD, Vitamin D versus PTH, and PTH versus BMD was assessed using Pearson correlation. ANOVA test was performed to assess quantitative data. All the statistical tests were performed at a significance level of $\alpha = 0.05$ and using.

RESULTS

Of the 369 athletes, 43 (11.7%) were female and 326 (88.3%) were male. The mean age was 26.95 years (18–41 years). Two hundred and fifty-eight individuals (69.9%) were Vitamin D deficient, 51 individuals (13.8%) were Vitamin D insufficient and 60 individuals (16.3%) were Vitamin D sufficient. 255/369 (69.1%) athletes had normal BMD (Z-score -1 or above), 112/369 (30.4%) had osteopenia (Z-score <-1 to -2.5), and 2/369 (0.5%) had osteoporosis (Z-score <-2.5). Overall, 114/369 (30%) athletes had low BMD and out of these 114 athletes, 108 (95%) were Vitamin D deficient. BMI, age, and gender [Table 1] were observed to be comparable in patients having low BMD and normal BMD (n. s.). Serum PTH levels were found to have an inverse relation to BMD ($r = -0.267$; $P < 0.001$).

Mean BMD (Z-score) was found to be -0.5 ± 1.04 in the Vitamin D deficient individuals, 0.3 ± 0.78 in Vitamin D insufficient individuals, and 0.5 ± 0.92 in Vitamin D sufficient individuals. Vitamin D levels were directly associated with BMD ($r = 0.473$; $P < 0.001$) [Table 2]. Mean PTH in 369 athletes was 34.2 ± 15.12 ng/L. PTH was found to have an inverse relation to Vitamin D ($r = -0.629$; $P < 0.05$) [Table 2].

DISCUSSION

The result of this study validates the definition of Vitamin D deficiency used by Western countries in the Indian population also. In this study, it was observed that >2/3rd (69%) of the enrolled athletes (ages 18–40 years) were Vitamin D deficient and one-third of athletes had low BMD.

Varied definitions have been stated for Vitamin D deficiency levels in the literature.^[10,11] Still, there is no consensus regarding the optimum value of Vitamin D. Australian guidelines recommended Vitamin D levels should be ≥ 50 nmol/l and >60 nmol/l in winters and summers, respectively.^[12] A recent meta-analytic study also suggested that a Vitamin D level of ≥ 50 nmol/l is required to normalize the PTH levels.^[13] Although, Priemel *et al.* reported mineralization defect in patients having serum Vitamin D levels <75 nmol/l and recommend serum Vitamin D levels should be more than >75 nmol/l.^[14] In the present study, the optimum value of Vitamin D was considered to be >30 ng/ml or >75 nmol/l and to validate this, two parameters were analyzed in the present study:-secondary hyperparathyroidism and BMD.

Table 1: Correlation of age, gender, and body mass index with bone mineral density

Z-score BMD	≥ -1 (n=255)	-1--2.5 (n=112)	<-2.5 (n=2)	P*
Mean age (years)	26.67±4.23	27.36±3.8	40.50	0.14
Male:female	231: 24	95: 17	0: 2	0.1
BMI (kg/m ²)	24.2±1.7	23.9±1.8	24.5±2.0	0.13

*P-value was calculated between BMD ≥ -1 and -1 – -2.5 group.

BMI: Body mass index, BMD: Bone mineral density

Table 2: Correlation of Vitamin D with bone mineral density and parathyroid hormone levels

	Vitamin D deficient (<20 ng/ml); (n=258), n (%)	Vitamin D insufficient (20-30 ng/ml); (n=51), n (%)	Vitamin D sufficient (>30 ng/ml); (n=60), n (%)	P
Z score \geq -1	150 (58)	48 (94)	57 (95)	<0.001
-1--2.5	106 (41)	3 (6)	3 (5)	<0.001
<2.5	2 (1)	0	0	
Mean PTH	39.9 \pm 12.7	24.7 \pm 10.3 ng/L	18.3 \pm 12.9 ng/L	<0.001
Male:female	226: 32	46: 5	54: 6	0.792

PTH: Parathyroid hormone

Secondary hyperparathyroidism occurs due to Vitamin D deficiency and normal PTH levels indicate Vitamin D sufficiency.^[10,15] Although some of the previous studies reported no correlation between Vitamin D and PTH,^[16] the Vitamin-D levels were observed to have an inverse relation with PTH levels in the present study. Another important parameter for the determination of Vitamin D deficiency is BMD. Vitamin D significantly contributes to BMD.^[10] However, some studies observed that the relationship between Vitamin D and BMD is inconsistent.^[15,17] Contrary to this, in the present study, it was observed that Vitamin D deficiency had an association with BMD. Further, both parameters indicate that reference values used to classify Vitamin D levels are validated for the healthy Indian population.

This study had some limitations (1) the effect of calcium intake on Vitamin D level was not studied in the present study. (2) This was a cross-sectional study, so the effect of Vitamin D supplementation on improvement of BMD and PTH levels also was not studied. (3) The majority of the athletes in the present study were males which are because of male dominance in sports, especially in this part of the world. However, this study is unique as most of the previous studies on the Indian population were conducted on relatively older age group patients (>40 years). Where the role of Vitamin D deficiency in osteomalacia and rickets has been studied extensively, there is little information on the effects of Vitamin D deficiency in apparently healthy individuals without any obvious bone disease.^[2] The present adds to the literature on this shortcoming and gives introspection on Vitamin D deficiency in healthy Indian sports persons.

CONCLUSIONS

Vitamin D deficiency is highly prevalent among North Indian athletes and the presence of low Vitamin D levels are associated with low BMD and high PTH levels.

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Conflicts of interest

There are no conflicts of interest.

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