

Original Research Article

SERUM VITAMIN D STATUS AMONG ATHLETES IN MANIPUR: A CROSS-SECTIONAL STUDY

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Received : 23/04/2026
Received in revised form : 11/06/2026
Accepted : 28/06/2026

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DOI: 10.70034/ijmedph.2026.3.106

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 644-648

ABSTRACT

Background: Vitamin D plays an important role in musculoskeletal health, muscle strength, and athletic performance. Athletes are considered vulnerable to vitamin D insufficiency despite regular physical activity. Data regarding vitamin D status among athletes from northeastern India are limited. The objective is to assess serum 25-hydroxy vitamin D [25(OH)D] levels among regularly trained athletes in Manipur.

Materials and Methods: This study was conducted in the Department of Physiology, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur, on regularly trained healthy young athletes. 25(OH)D levels were estimated using ELISA. Statistical analysis was performed using SPSS version 21.

Results: The mean serum vitamin D level among the athletes was 33.48 ± 8.01 ng/ml. Male athletes had a higher mean vitamin D level (34.69 ± 9.89 ng/ml) than female athletes (31.91 ± 4.29 ng/ml; $p=0.204$). Out of 55 athletes, 36 (65%) had sufficient vitamin D levels and 19 (35%) had vitamin D insufficiency. None of the athletes had vitamin D deficiency. Cyclists demonstrated relatively higher vitamin D levels compared to sepak takraw players.

Conclusion: Most athletes in the present study had sufficient vitamin D levels, although a considerable proportion demonstrated vitamin D insufficiency. Regular monitoring and preventive strategies may help maintain optimal vitamin D status among athletes.

Keywords: Vitamin D; Athletes; 25-hydroxy vitamin D; Sports physiology; Manipur.

INTRODUCTION

Vitamin D is a fat-soluble secosteroid hormone that plays an important role in calcium and phosphorus homeostasis, skeletal mineralization, immune regulation, neuromuscular function, and maintenance of bone health.^[1] In addition to its classical skeletal effects, vitamin D also influences muscle strength, mitochondrial oxidative function, inflammatory responses, and physical performance.^[2,3]

Vitamin D deficiency and insufficiency have emerged as important global public health concerns affecting all age groups.^[1] Athletes are considered particularly vulnerable because intense physical activity increases musculoskeletal demands and may predispose them to fatigue, muscle weakness, stress

fractures, and impaired athletic performance in the presence of inadequate vitamin D levels.^[2,4] Several studies have reported a high prevalence of vitamin D insufficiency among athletic populations, including both indoor and outdoor athletes.^[5-8]

Serum 25-hydroxy vitamin D [25(OH)D] is considered the best indicator of vitamin D status because it reflects endogenous synthesis and dietary intake.^[9] Vitamin D levels are generally classified as sufficient (>30 ng/ml), insufficient ($20-30$ ng/ml), and deficient (<20 ng/ml).^[9]

The prevalence of vitamin D insufficiency among athletes varies depending on geographical location, seasonal variation, skin pigmentation, dietary habits, type of sport, and duration of sunlight exposure.^[6,8] Athletes involved in indoor sports have been reported to have lower vitamin D levels compared to those

involved in outdoor activities due to reduced sunlight exposure.^[7]

Manipur is a northeastern state of India known for active participation in sports such as sepak takraw and cycling. However, limited studies have assessed vitamin D status among athletes from this region. Therefore, the present study was undertaken to determine serum vitamin D levels among athletes of Manipur and evaluate differences in vitamin D status among different categories of athletes.

Objective: To assess serum 25-hydroxy vitamin D levels among regularly trained athletes in Manipur.

MATERIALS AND METHODS

This cross-sectional study was carried out in the Department of Physiology, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur, in collaboration with Sports Authority of India, Takyel, Manipur, after obtaining approval from the Research Ethics Board, RIMS (Approval No. A/206/REB-Comm(SP)/RIMS/2015/449/67/2018 dated 30th January, 2019). The study was conducted over a period of two years from September 2018 to August 2020 among 55 healthy athletes aged 15–30 years from the academy of Sports Authority of India, Manipur. Athletes who were regularly trained (>5 times per week or >6 hours per week) for at least one year were included in the study. Participants unwilling to participate, chronic smokers, alcoholics, substance abusers, and athletes with chronic diseases such as diabetes mellitus, cardiovascular diseases, kidney diseases, lung diseases, and hematological disorders were excluded from the study. Participants were selected conveniently from Sports Authority of India, Takyel, Manipur. Athletes present on the day of visit and willing to participate were included in the study. Written informed consent was obtained from all willing participants after explaining the objectives

and procedure of the study. Assent was obtained from participants below 18 years of age.

Personal information regarding age, sex, and type of sports involved were collected using a pre-designed proforma. General and systemic examinations were performed and anthropometric measurements including height, weight, and body mass index (BMI) were recorded. Approximately 2 ml of venous blood was collected from the antecubital vein under aseptic precautions in a plain vial for serum vitamin D estimation by ELISA. Serum was separated from whole blood by centrifugation and stored at 2°C–8°C until analysis. Samples were brought to room temperature prior to analysis. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using Erba LisaScan EM Automated Microplate ELISA Reader (TRANSASIA BIO-MEDICAL Ltd., Mumbai) using the 25OH Vitamin D ELISA kit from DIA Source Company.

Participants were classified into the following categories according to serum vitamin D levels:

- Vitamin D sufficiency: ≥ 30 ng/ml
- Vitamin D insufficiency: 20–29 ng/ml
- Vitamin D deficiency: < 20 ng/ml

Statistical analysis was performed using SPSS software version 21. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequency and percentage. Student's t-test was used to compare mean values between groups and Chi-square test was used to determine association between variables. A p-value of < 0.05 was considered statistically significant.

RESULTS

The present study was conducted among 55 athletes who fulfilled the inclusion criteria. The mean age of the participants was 16.07 ± 1.55 years.

Table 1: Demographic characteristics of the study population (N=55)

Sl. No.	Variable	Mean $\pm$ SD
1.	Age (years)	16.07 ± 1.55
2.	Weight (kg)	57.15 ± 7.16
3.	Height (m)	1.62 ± 0.06
4.	BMI (kg/m ²)	21.80 ± 2.02

The mean weight, height, and BMI are shown in [Table 1].

Out of the total participants, 31 (56.4%) were males and 24 (43.6%) were females. The majority of athletes belonged to the under-18 age group [42 (76.4%)], while 13 (23.6%) were aged 18 years or

above. Among the sports categories included in the study, 34 (61.8%) participants were sepak takraw players and 21 (38.2%) were cyclists. Based on Asia-Pacific BMI classification, 35 (63.6%) athletes had normal BMI, 2 (3.6%) were underweight, 15 (27.3%) were overweight, and 3 (5.5%) were obese.

Table 2: Comparison of mean serum vitamin D levels according to gender and type of sport

Gender	Mean serum vitamin D (ng/ml)	P-value
Male (n=31)	34.69 ± 9.89	0.204
Female (n=24)	31.91 ± 4.29	
Types of sports		
Sepak Takraw (n=34)	32.16 ± 6.72	0.123
Cycling (n=21)	35.6 ± 9.53	

The overall mean serum vitamin D level among the study participants was 33.48 ± 8.01 ng/ml. [Table 2] compares the mean serum vitamin D level between male and female athletes belonging to different types of sports. Among the study participants, male athletes (n=31) had a higher mean serum vitamin D level (34.69 ± 9.89 ng/ml) compared to female athletes (n=24), who had a mean level of 31.91 ± 4.29 ng/ml. However, the difference in vitamin D levels between males and females was not statistically significant ($p=0.204$). Comparison according to type of sports revealed that cyclists (n=21) had relatively higher mean serum vitamin D levels (35.6 ± 9.53 ng/ml) than sepak takraw players (n=34), who had a mean value of 32.16 ± 6.72 ng/ml. However, the difference was not statistically significant ($p=0.123$).

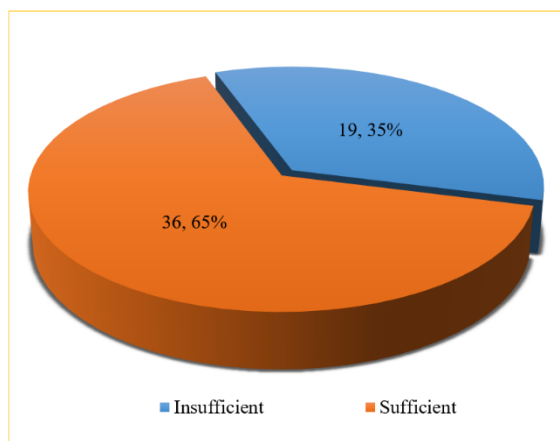


Figure 1: Vitamin D status in the whole study population (N=55)

Out of the 55 athletes studied, 36 (65%) had sufficient vitamin D levels and 19 (35%) had vitamin D insufficiency. None of the athletes had vitamin D deficiency as shown in [Figure 1].

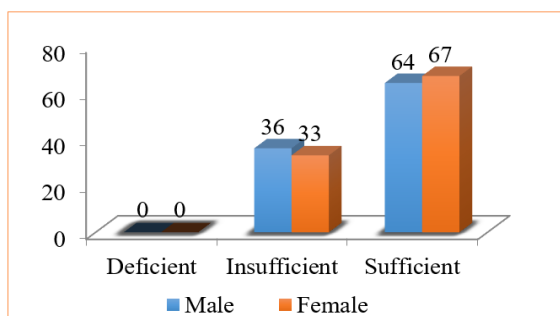


Figure 2: Gender-wise distribution of Vitamin D status (N=55)

Gender-wise analysis revealed that sufficient vitamin D levels were observed in 20 out of 31 (64%) male athletes and 16 out of 24 (66%) female athletes as shown in [Figure 2]. With respect to age groups, vitamin D insufficiency was observed in 12 (28.6%) athletes in the under-18 group and 7 (53.8%) athletes in the over-18 group. However, the association between vitamin D status and age group was not statistically significant ($p = 0.064$).

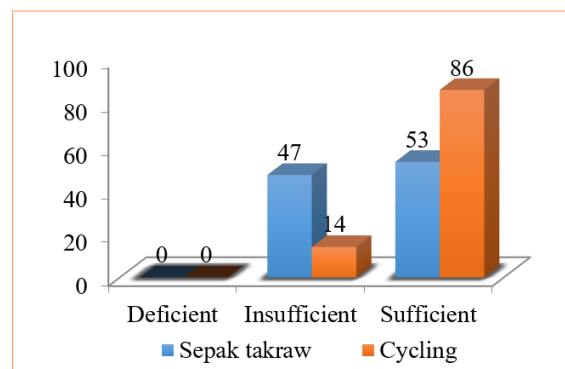


Figure 3: Comparison of vitamin D status in sepak takraw players and cyclists (N=55)

Among different sports categories, a higher proportion of cyclists demonstrated sufficient vitamin D levels compared to sepak takraw players as shown in [Figure 3].

DISCUSSION

Vitamin D is increasingly recognized as an important determinant of musculoskeletal health, immune regulation, neuromuscular function, and athletic performance. Adequate vitamin D status has been associated with improved muscle strength, reduced risk of stress fractures, enhanced recovery, and optimal physical performance among athletes.^[1-4] The present study assessed serum vitamin D levels among athletes from Manipur, a region where data on vitamin D status in athletic populations are scarce.

The mean serum 25(OH)D concentration observed in the present study was 33.48 ± 8.01 ng/ml, indicating overall sufficient vitamin D status among the study participants. Similar findings were reported by Close et al., who demonstrated relatively adequate vitamin D concentrations among professional athletes involved in regular outdoor training.^[5] Owens et al. also reported that athletes with frequent outdoor exposure generally exhibit higher vitamin D levels than the general population, owing to increased ultraviolet-B exposure.^[4]

Despite the overall satisfactory mean vitamin D concentration, 35% of athletes exhibited vitamin D insufficiency, highlighting that suboptimal vitamin D status remains common even among regularly trained athletes. This observation is consistent with the systematic review and meta-analysis by Farrokhyar et al., which reported vitamin D inadequacy in a substantial proportion of athletes worldwide, regardless of geographic location or sporting discipline.^[6] Similar findings have been reported among athletes from Europe, the Middle East, and Asia, where vitamin D insufficiency has been observed despite regular physical activity.^[7-10]

The absence of vitamin D deficiency among participants in the present study contrasts with reports from several international studies where deficiency rates ranged from 10% to 50%.^[6,8,11] This difference may be attributed to the predominantly outdoor

nature of training among the athletes studied and the favorable climatic conditions of Manipur, which permit year-round sunlight exposure. Cutaneous synthesis following ultraviolet-B exposure remains the principal source of vitamin D for most individuals.^[1,9] Nevertheless, adequate sunlight availability does not necessarily guarantee optimal vitamin D status because factors such as clothing habits, sunscreen use, skin pigmentation, training schedules, and dietary intake may significantly influence vitamin D synthesis.^[12,13]

Male athletes demonstrated higher mean serum vitamin D levels than female athletes, although the difference was not statistically significant. Similar observations have been reported by Close et al. and Villacis et al., who found no significant sex-related differences after adjustment for training characteristics and sunlight exposure.^[5,14] The relatively lower vitamin D levels among female athletes observed in some studies have been attributed to differences in body fat percentage, hormonal influences, dietary habits, and reduced sun exposure.^[14,15]

Cyclists exhibited higher mean serum vitamin D levels than sepak takraw players. Although the difference did not reach statistical significance, this finding may reflect the greater duration of outdoor exposure typically experienced by cyclists. Previous investigations have consistently demonstrated higher vitamin D concentrations among outdoor athletes compared to indoor athletes.^[7,16] Constantini et al. reported significantly lower vitamin D levels among indoor athletes and dancers, emphasizing the influence of sunlight exposure on vitamin D status.^[7] Age-related analysis revealed a higher proportion of vitamin D insufficiency among athletes aged 18 years and above compared to younger athletes. Although the association was not statistically significant, the trend may reflect lifestyle differences, academic commitments, altered dietary patterns, or reduced cumulative sunlight exposure among older athletes. Similar age-related variations have been described in studies evaluating vitamin D status among adolescents and young adults.^[17]

Vitamin D insufficiency in athletes is clinically important because inadequate vitamin D levels have been associated with reduced muscle strength, impaired neuromuscular coordination, increased susceptibility to stress fractures, prolonged recovery from injury, and diminished athletic performance.^[2,3,18] Emerging evidence also suggests that vitamin D may influence inflammatory responses, immune function, and mitochondrial activity, all of which contribute to athletic performance and recovery.^[4,19]

Strengths and limitations: The present study has several limitations. The sample size was relatively small, and participants were recruited from a single sports academy, limiting generalizability. Important determinants of vitamin D status, such as dietary intake, duration of sunlight exposure, skin pigmentation, use of vitamin D supplements,

seasonal variation, and body composition, were not assessed. Furthermore, the cross-sectional design precludes causal inferences regarding determinants of vitamin D status.

Despite these limitations, the study provides valuable baseline data regarding vitamin D status among athletes from northeastern India, a region for which published literature remains limited. The inclusion of athletes from two different sporting disciplines further contributes to understanding sport-specific variations in vitamin D status.

CONCLUSION

The present study demonstrated that the majority of athletes from Manipur had sufficient serum vitamin D concentrations, with a mean serum 25(OH)D level of 33.48 ± 8.01 ng/ml. However, vitamin D insufficiency was identified in more than one-third of participants, indicating that suboptimal vitamin D status remains a relevant concern even among regularly trained athletes. Male athletes and cyclists exhibited relatively higher vitamin D levels than female athletes and sepak takraw players, although these differences were not statistically significant. No participant was found to have vitamin D deficiency, which may reflect the benefits of regular outdoor training and adequate sunlight exposure in this population.

Given the established role of vitamin D in musculoskeletal health, immune function, injury prevention, and athletic performance, periodic monitoring of vitamin D status should be considered among athletes. Nutritional counselling, appropriate sunlight exposure, and targeted supplementation when indicated may help optimize vitamin D status and support athletic performance. Future multicentric studies with larger sample sizes should explore the role of dietary, environmental, and lifestyle factors in determining vitamin D status among Indian athletes.

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