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PREVALENCE OF HYPO VITAMINOSIS D AMONG THE OUTDOOR AND INDOOR ATHLETES OF MANIPUR, A NORTH EASTERN STATE OF INDIA: A CROSS-SECTIONAL STUDY

Medicine

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ABSTRACT

Background: Although vitamin D deficiency has been documented as a frequent problem in studies of young adults and sportspersons in other countries and also in our country, there are limited data on the prevalence of this nutritional deficiency among the apparently healthy sportspersons in the North Eastern part of our country particularly in the state of Manipur. **Objectives:** To estimate the prevalence of vitamin D deficiency in apparently healthy sportspersons of Manipur aged 12 to 40 years. **Study Design:** Cross-Sectional Study **Material and Methods:** A Cross sectional study was conducted in the department of Sports Medicine, RIMS, Imphal among the athletes presenting to the OPD meeting the inclusion and exclusion critetria. Serum vitamin D was analyzed by using Automated Microplate ELISA Reader and data collected was analyzed by using SPSS version 21(IBM). **Results:** Majority of the sportsperson, 156(76.4%), were found to have low levels of serum Vitamin D. Indoor sportspersons were found to have lower levels of S.Vitamin D in comparison with outdoor sportspersons ($p<0.05$). The indoor athletes also showed significantly higher mean percentage of body fat than outdoor athletes, $14.17 \pm 4.97\%$ and $9.80 \pm 2.76\%$ respectively. The serum 25(OH)D levels of indoor athletes were significantly lower than those of outdoor athletes, 21.01 ± 9.84 ng/mL and 28.80 ± 10.85 ng/ml, respectively ($P < 0.001$). Furthermore, the sportspersons with vitamin D deficiency were found to twice as likely have a chance of fracture/ stress fracture (Odds ratio=2.08). **Conclusion:** In conclusion, a majority of the elite sportspersons in Manipur were found to have inadequate levels of Vitamin D, the prevalence of which was higher among the indoor sportspersons than outdoor.

KEYWORDS

Vitamin D, indoor and outdoor athletes, body fat percentage, fracture

INTRODUCTION

Vitamin D deficiency is now recognized as a pandemic. Over the past decade, interest in research in relation to vitamin D (Vit D) has been growing exponentially, partly due to the increased prevalence of its deficiency in the population and the association between the deficiency of Vitamin D and a wide range of diseases. The importance and versatility of vitamin D in the organism is becoming increasingly evident. Vitamin D plays an active role in immune function, protein synthesis, muscle function, cardiovascular function, inflammatory response, cell growth and musculoskeletal regulation.[1] In addition, vitamin D deficiency has been correlated to the risk of bone stress fractures. Bone stress fracture is a common overuse injury in elite athletes. On the other hand, it is reported that obesity is one of the risk factors of vitamin D deficiency. Furthermore, vitamin D level is inversely related to body weight, BMI, and percentage of body fat.[2] In relation to vitamin D and its role in athletes, an important field of research on its influence on bone balance, muscle resistance and athletic performance is currently underway. Athletes might seem to have sufficient levels of Vitamin D. However, the latest research shows that this assumption is wrong. In the last decade, the scientific community has conducted studies on Vit D levels in various groups of athletes including runners, basketball players, jockeys, gymnasts and even dancers, showing that these levels in athletes are comparable to those of the general population.[3]

The synthesis of vitamin D is influenced by the amount of sunlight (ultraviolet B radiation, 290–315 nm wavelength) on exposed skin. Before it can begin its activity, it must be metabolically activated by hydroxylation, a process that takes place in the liver and subsequently in the kidneys and is modulated by multiple factors, such as 1,25(OH)2D, the phosphate and calcium levels in the blood, and the parathyroid hormone. A negative impact on circulating levels could be caused by indoor activity, life at high latitudes, and other environmental or occupational factors.[4]

Vitamin D is critical to many biological processes in the musculoskeletal system, with a strong correlation noted between vitamin D sufficiency and optimal muscle function. Physiologically, these deficient states produce muscle fiber atrophy, slow peak muscle contraction, prolonged time to muscle relaxation, and increased risk of chronic musculoskeletal pain. Increasing vitamin D levels provides multiple musculoskeletal benefits such as increase in muscle protein synthesis, ATP concentration, strength; jump height, jump velocity, jump power, exercise capacity, and physical performance are achieved with increased vitamin D levels.[5] It is well known that vitamin D plays an important role in bone health and fracture prevention. Recent studies have shown that vitamin D has immunomodulatory effects, with increased vitamin D levels reducing inflammation. Also, pro inflammatory cytokines such as TNF-alpha and interleukin-6 are

increased with lower levels of serum 25(OH) D, especially after intense periods of exercise. This period of increased inflammation has been theorized as one of the potential causes of "overtraining" or "overreaching" syndrome. Theoretically, if athletes increased their levels of vitamin D by supplementation, inflammation would be reduced, and training could be resumed more quickly.[6]

Although vitamin D deficiency has been documented as a frequent problem, there are limited data on the prevalence of this nutritional deficiency among the sportspersons in the North Eastern part of our country particularly in the state of Manipur. Considering the aforementioned importance of vitamin D for an athlete's quality of life and performance and that its level is closely linked to sun exposure, a cross-sectional study was done with the primary aim to compare vitamin D sufficiency between indoor and outdoor elite athletes. The secondary aim is to evaluate the association between vitamin D level, the incidence of stress fractures, and body composition including body fat.

MATERIALAND METHODS

Study Design: Cross Sectional study

Study Setting: Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal. In a year, around 5500 patients are seen in the outpatient department.

Duration Of Study: 6 months starting from September 2022

Study Tool: 25-OH Vitamin D Total ELISA (DIA source kit), Belgium Microplate ELISA Reader (Model no. SR no. 120710 Scan EM Transia Bio-Medical Ltd., Mumbai).

Study Population

204 athletes attending the Sports Medicine OPD meeting the following inclusion and exclusion criteria were selected for the study

Inclusion Criteria

1. Apparently healthy athletes of Manipur visiting the Sports Medicine OPD for injury or routine health check up
2. Age between 12 to 40 years of age
3. Willingness to provide consent/ ascent in case of <18 years

Exclusion Criteria

1. Athletes with any history of chronic diseases
2. History of thyroid, parathyroid, adrenal or gonadal disease
3. History of any metabolic bone disease
4. Malignancy
5. Hepatic and Renal disease
6. Malabsorption syndrome or history of gastrointestinal resection, chronic diarrhea.

Data Collection

Participation was voluntary, and the participants were provided a thorough explanation of the objectives, methods, and ethical considerations of this study. A written informed consent and ascent in case of children was obtained from all the participants included in the study. The participants' demographic information was prospectively recorded, including age, height, practice time with sunlight exposure, and past medical history of stress fractures and other fractures by written questionnaire. Furthermore, all the athletes' body weight, body fat percentage, muscle mass, and bone mass were measured using a body composition analyzer. Blood samples were collected to check the levels of serum calcium, phosphorus, and 25(OH) D at the same day as the body composition monitoring. Serum 25(OH)D levels were analyzed using 25-OH Vitamin D Total ELISA (DIA source kit), Belgium Microplate ELISA Reader (Model no. SR no. 120710 Scan EM Transia Bio-Medical Ltd., Mumbai). Serum calcium levels were measured through an enzymatic method using phospholipase D. Serum inorganic phosphate levels were measured through an enzymatic method using purine nucleoside phosphorylase. Participants were divided into the following three items according to serum vitamin D levels: vitamin D sufficiency (serum 25(OH)D levels greater than or equal to 30 ng/ml), vitamin D insufficiency (serum 25(OH)D levels less than 30 ng/ml but not less than 20 ng/ml), and vitamin D deficiency (serum 25(OH)D levels less than 20 ng/ml) groups.

Analysis

Data was collected and analyzed statistically by using SPSS version 21(IBM). Descriptive statistics like mean, standard deviation, percentages and correlations were used. P-value of < 0.05 is taken as statistically significant.

Ethical approval of the Research Ethics Board, RIMS, Imphal was taken for this clinical study.

RESULTS

A total of 204 athletes (115 males and 89 females) from various disciplines were selected for the study and divided into outdoor and indoor athletes. The majority of the athletes were Footballers (n=48), followed by Judo/Wushu (n=28), Cricket (n=24), Swimming (n=24), Boxing (n=20), Athletics (n=12), Sepak Takraw (n=8) and Badminton (n=8). The mean age of the Outdoor group was 23.76 ± 5.53 years and that of the indoor group was 21.48 ± 4.2 years. Both the indoor and outdoor athletes had similar mean duration of practice time 3.40 ± 0.57 hrs/day and 3.52 ± 0.51 hrs/day respectively. Furthermore, the indoor athletes showed a significantly higher mean percentage of body fat than the outdoor athletes, 14.17 ± 4.97 % and 9.80 ± 2.76 % respectively. (Table. I). Out of 102 indoor athletes, 85 (83.33%) had a body fat percentage of > 10% while 45 out of 102 (44.11%) outdoor athletes had a body fat percentage of >10%. (Table III)

The mean serum 25(OH)D level of all the athletes was 24.91 ± 10.98 ng/ml. Overall, of the 204 athletes, 72 (35.29%) were classified as vitamin D deficiency, 84 (41.17%) were classified as vitamin D insufficiency, 48 (23.52%) were classified as vitamin D sufficiency. (Figure 1). The serum 25(OH) D levels of the indoor athletes were significantly lower than those of the outdoor athletes, 21.01 ± 9.84 ng/ml and 28.80 ± 10.85 ng/ml, respectively (P < 0.01). (Table. 1). Furthermore, the indoor athletes showed a significantly higher rate of vitamin D deficiency or insufficiency than the outdoor athletes, 89 out of 102 (87.25%) and 65 of 102 (63.7%), respectively (Odds ratio = 3.89) (Table. II) . The serum calcium levels of the indoor athletes were significantly lower than those of the outdoor athletes, 9.51 ± 0.76 ng/ml and 10.18 ± 0.74 ng/ml, respectively (P < 0.00).

In terms of past medical history, of the 204 participants, a total of 34 athletes had a past history of stress fracture/fracture. Out of this 34, 29 (85.29%) athletes were found to have deficient or inadequate levels of S. Vitamin D. (Odds ratio = 2.08) (Table. IV).

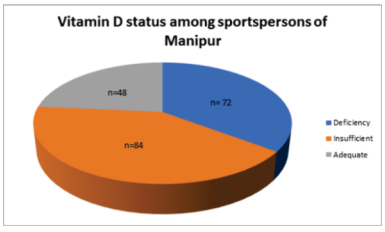

Fig 1: Vitamin D Status Among Sportspersons Of Manipur (n = 204)

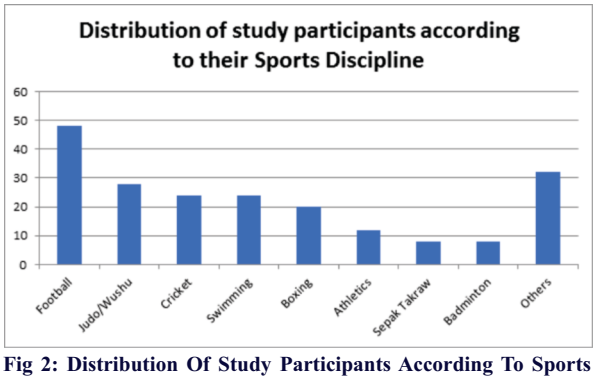

Fig 2: Distribution Of Study Participants According To Sports Discipline (n = 204)

Table I: Comparisons Of Background And Laboratory Parameters Between Outdoor And Indoor Sportspersons Of Manipur

Characteristics	Group		p-value#
	OUTDOOR Group	INDOOR Group	
Mean Age (years)	23.76 ± 5.53	21.48 ± 4.2	0.110
Mean duration of PRACTICE time (hours)	3.52 ± 0.51	3.40 ± 0.57	0.440
BODY FAT %	9.80 ± 2.76	14.17 ± 4.97	0.00
S. VIT D (ng/dl)	28.80 ± 10.85	21.01 ± 9.84	0.01

S. CALCIUM	10.18 ± 0.74	9.51 ± 0.76	0.00
GENDER*			
MALE	60	55	1.00
FEMALE	42	47	

#Independent T test

Table II: Vitamin D Status Among The Outdoor And Indoor Sportspersons Of Manipur

Demography	Serum vitamin D		ODDS RATIO
	Deficiency / Insufficient	Adequate	
Indoor(N)	89	13	3.89
Outdoor (N)	65	37	

Table III: Corelation Between Body Fat % And The Type Of Sport

Body fat percentage among the outdoor and indoor athletes of manipur			
Demography	Body fat %		Odds ratio
	>10%	<10%	
Indoor (N)	85	17	6.3
Outdoor (N)	45	57	

Table IV: Corelation Between Fracture/ Stress Fracture And Type Of Sport

H/o fracture/ stress fracture	S. VIT D		ODDS RATIO
	Deficiency / Insufficient	Adequate	
YES (N)	29	5	2.08
NO (N)	125	45	

DISCUSSION

Vitamin D has a significant impact on bone health, immune function, and physical performance. When there is deficiency, athletes may be at an increased risk of decreased performance, stress fractures, respiratory infections, and muscle injuries.[14] The present study showed that the serum 25(OH) D levels of majority of the athletes were either deficient or insufficient for optimal health. Furthermore, the indoor elite athletes were found to have significantly lower serum 25(OH) D levels than those of the outdoor elite athletes.

Maruyama-Nagao et al[13] reported that indoor sports athletes are more susceptible to vitamin D insufficiency compared with outdoor sports athletes, especially in winter.[17] Sunlight exposure can increase vitamin D levels, and a significant amount of active vitamin D circulating in the body is a result of sunlight exposure.[14] One possible reason why our study had a similar finding could be because the study was conducted during the autumn and winter months.

However, even among the outdoor athletes, the prevalence of vitamin D insufficiency is high, at 63.72%. Hamilton et al reported that 91% of 93 athletes showed vitamin D deficiency or insufficiency.[15] Lovell reported vitamin D insufficiency in 33% of female Australian gymnasts.[16] These results showed that athletes might be prone to vitamin D deficiency. Vitamin D deficiency increased the risk of fractures including stress fractures in Finnish military recruits.[17] In the present study, the elite athletes with history of vitamin D deficiency were twice as likely to have a past history of stress fracture/ fractures. Therefore, the present study implies that vitamin D level is very important in reducing the incidence of fractures. Thus, we recommend creating awareness about the importance of Vitamin D and its role in the body among the elite athletes of Manipur. Another finding of the present study was the significant difference of body fat percentage between the indoor and outdoor athletes. Arunabh et al[18] reported that the percentage of body fat is inversely related to the serum 25(OH)D level. Worstman et al[19] explained that vitamin D insufficiency associated with obesity is due to decreased bioavailability of vitamin D from the cutaneous and dietary sources because of its deposition in body fat compartments. However, Salepour et al showed that increasing vitamin D levels by supplementation led to body fat mass reduction in a randomized controlled trial.[20] Therefore, the association between body fat and serum 25(OH)D level remains unclear. However, the significant difference of body fat percentage between the indoor and outdoor athletes in this study might come from the difference in vitamin D levels between them, although we cannot deny the possibility that it might arise from differences in sports types. This study had a few limitations. The first is the inherent uncertainty regarding testing of vitamin D levels and the definition of exactly how much of vitamin D is sufficient. The histories of fractures were self-reported, which may have introduced error. Finally, a larger sample size would have been ideal considering Manipur is the powerhouse of sports in our country.

CONCLUSION

In this study, 156(76.4%) athletes were found to have either deficient or insufficient 25-OH(D) level. There was significant difference in 25-OH(D) level between outdoor and indoor athletes and the study also found that mean body fat % was significantly higher among indoor athletes. The study also found that athletes with 25-OH(D) deficiency were twice as likely to have a history of fracture/stress fracture. Hence, we concluded that there was a high prevalence of hypovitaminosis D in apparently healthy sportspersons of Manipur. Therefore, creating awareness and education of the athletes and coaches about the importance of vitamin D is of utmost importance to further improve the overall health of the athlete and in turn result in enhanced sporting performance.

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Conflicts Of Interest: None

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