

## RESEARCH ARTICLE

# A Study on Association of Degree of Physical Exercise and Plasma 25-(OH) Vitamin D Levels

<sup>1</sup>Sandeep S Soam, <sup>2</sup>Thokchom O Singh, <sup>3</sup>Sonali Chaturvedi, <sup>4</sup>Gautam Sarkar

## ABSTRACT

**Aim:** To determine whether vitamin D deficiency is related to the degree of physical activity or not.

**Materials and methods:** A total of 113 Bachelor of Medicine and Bachelor of Surgery (MBBS) students of the same batch aged 17 to 21 years (59 boys and 54 girls) were included in this case-control study. Levels of physical activity were determined using a self-prepared questionnaire.

**Results:** According to vitamin D grading, only 19 (16.8%) students were in normal category, rest of them were either in deficient (69.9%) or in insufficiency (13.3%) category.

Age-matched comparisons between case group and control group revealed that those physically active had higher levels of vitamin D as compared with those with lower physical activity.

**Conclusion:** Plasma vitamin D deficiency was prevalent even in apparently healthy young individuals. In the case group (who are physically active), the mean of serum vitamin D level was significantly higher (23 ng/dL) than the control group (10.5 ng/dL). Serum vitamin D deficiency was more prevalent in females.

**Clinical significance:** This study clearly shows that the increased physical activity, especially in sunlight, among individuals should be encouraged not only at home but also at their school and workplace to promote a more active lifestyle that will counteract not only vitamin D deficiency but other benefits as well.

**Keywords:** MBBS students, Physical activity, Vitamin D.

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<sup>1</sup>Assistant Professor, <sup>2</sup>Tutor, <sup>3</sup>Senior Resident, <sup>4</sup>Professor

<sup>1</sup>Department of Biochemistry, Muzaffarnagar Medical College Muzaffarnagar, Uttar Pradesh, India

<sup>2</sup>Department of Biochemistry, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India

<sup>3</sup>Department of Biochemistry, Maulana Azad Medical College New Delhi, India

<sup>4</sup>Department of Biochemistry, Subharti Medical College, Meerut Uttar Pradesh, India

**Corresponding Author:** Sandeep S Soam, Assistant Professor Department of Biochemistry, Muzaffarnagar Medical College Muzaffarnagar, Uttar Pradesh, India, Phone: +918791890746 e-mail: 1982shravansoam@gmail.com

## INTRODUCTION

Vitamin D is a fat-soluble micronutrient that received considerable clinical and research interest in recent years, starting from its importance on bone health. Vitamin D had been a topic of debate for several reasons, including the issue of food fortification and the recommended daily allowance.

There are sufficient data to indicate the regulatory role of vitamin D on skeletal muscle physiology originating from clinical observations and vitamin D interventions. These suggest the role of increasing serum 25(OH)D concentrations in improving skeletal muscle strength or function in patients with osteomalacia.<sup>1</sup> Unlike other vitamins, vitamin D is a secosteroid hormone, not a cofactor in an enzymatic reaction or an antioxidant.

Cutaneous production from ultraviolet B radiation, present in sunlight, and not dietary intake, is the principal source of circulating human vitamin D stores. Most natural human diets contain little vitamin D, unless they include fatty fish.<sup>2</sup> We hypothesize that serum vitamin D levels are a possible function of the extent of physical activity. In the present study, we attempt to verify our hypothesis.

## MATERIALS AND METHODS

This was a hospital-based prospective study conducted in the Department of Biochemistry, Subharti Medical College, Meerut, Uttar Pradesh, India. A total of 113 subjects were studied. Consent was obtained from all subjects, after due information was provided, including possible risks. In the study group category, all voluntary and apparently healthy students with physical activity (who performed physical exercise, indoor or outdoor, for a minimum of at least 30 minutes per day and thrice a week) were included. This group included 63 subjects with 40 (63.5%) males and 23 (36.5%) females and mean age of  $18.26 \pm 1.76$  years. Subjects taking vitamin D supplements and suffering from chronic diseases, which are suggested as per history and examination, were excluded at the time of enrolment.

Control group includes 50 subjects with 19 (38%) males and 31 (62%) females and mean age of  $18.12 \pm 2.08$  years were matched with study group, and individuals taking vitamin D supplements and suffering from

**Table 1:** Gender distribution in study group according to vitamin D grade

Gender	Vitamin D grade		Study group		Total (%)
			Case (%)	Control (%)	
Male	Vitamin D grade	Deficiency	19 (47.5)	16 (84.2)	35 (59.3)
		Insufficiency	9 (22.5)	1 (5.3)	10 (16.9)
		Normal	12 (30.0)	2 (10.5)	14 (23.7)
		Total	40 (100.0)	19 (100.0)	59 (100.0)
Female	Vitamin D grade	Deficiency	14 (60.9)	30 (96.8)	44 (81.5)
		Insufficiency	4 (17.4)	1 (3.2)	5 (9.3)
		Normal	4 (21.7)	0 (0.0)	4 (9.3)
		Total	23 (100.0)	31 (100.0)	54 (100.0)
Total	Vitamin D grade	Deficiency	33 (52.4)	46 (92.0)	79 (69.9)
		Insufficiency	13 (20.6)	2 (2.0)	15 (13.3)
		Normal	16 (27.0)	2 (4.0)	18 (16.8)
		Total	63 (100.0)	50 (100.0)	113 (100.0)

chronic diseases, which are suggested as per history and examination, were excluded at the time of enrolment.

### Biochemical Analysis

Venous blood samples were collected after about 12 hours of fasting, in ethylenediaminetetraacetic acid vials<sup>3</sup> from both the study groups. Care was taken to prevent hemolysis of the sample. Hemolyzed samples were discarded. The plasma was separated from each blood sample and stored in deep freezer at  $-80^{\circ}\text{C}$  separately. Samples were processed for plasma 25(OH) vitamin D assessment by Robonik enzyme-linked immunosorbent assay (ELISA) Reader and Washer with Sandwich ELISA kit method from Euroimmun Medizinische Labordiagnostika AG. According to the manufacturer, the limit for detection of 25(OH) vitamin D by the kit method was 1.6 ng/mL. Reference interval for vitamin D<sup>4</sup>: deficiency  $<20$  ng/mL, insufficiency 20 to 30 ng/mL, normal 30 to 70 ng/mL, elevation 70 to 150 ng/mL, intoxication  $>150$  ng/mL. Prior to the study, due approval was obtained from the Institutional Ethical Committee.

### Statistical Analysis

Data were analyzed using Microsoft Excel 2007, R2.8.0 Statistical Package for the Social Sciences for Windows version 16.0 (SPSS Inc.; Chicago, Illinois, USA). Comparison between the mean of continuous data of case group and control group was done by unpaired Student's t-test. The data were presented as means  $\pm$  standard deviation (SD) with p-value of  $<0.05$  being indicative of statistical significance.

### RESULTS

The present study was conducted on 113 subjects, i.e., 63 subjects in study group and 50 subjects in control group. The age of all the subjects was distributed between

17 and 21 years. The following observations were made from this study: In the case group, 40 (63.5%) were males and 23 (36.5%) were females, while in the control group, 19 (38%) were males and 31 (62%) were females. According to vitamin D grading, 19 (47.5%) males in the case group and 16 (84.2%) males in the control group were in deficiency category; 9 (22.5%) males in the case group and 1 (5.3%) male in the control group were in insufficiency category; 12 (30%) males in the case group and 2 (10.5%) males in the control group were in normal category.

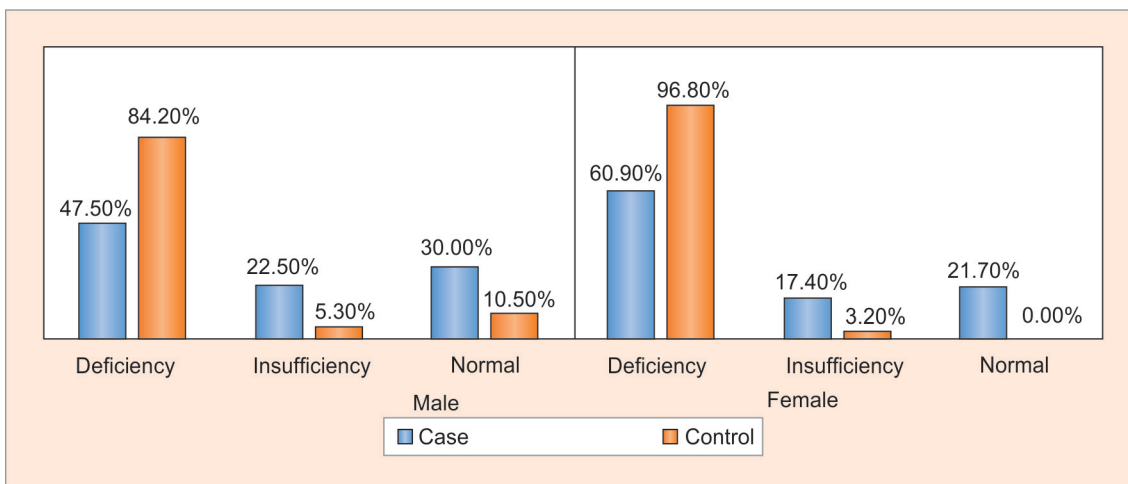
According to vitamin D grading, 14 (60.9%) females in the case group and 30 (96.8%) females in the control group were in deficiency category; 4 (17.4%) females in the case group and 1 (3.2%) female in the control group were in insufficiency category; 4 (17.4%) females in the case group and 0 (0%) female in the control group were in normal category; 1 (4.3%) female in the case group and 0 (0%) female in the control group were in elevation category (Table 1 and Graph 1).

Table 2 shows in the study group, mean  $\pm$  SD for case group was  $23.0 \pm 15.3$ , and for control group it was  $10.5 \pm 7.1$ . It was observed that mean  $\pm$  SD levels for serum vitamin D was raised in the case group as compared with the control group (Table 2). On applying the unpaired Student's t-test, it was found that serum vitamin D levels in the case group and control group were statistically extremely significant at  $p < 0.0001$  level of significance.

In the study group, the plasma vitamin D levels are higher for the case group ( $23.0 \pm 15.3$  ng/mL) than the control group ( $10.5 \pm 7.1$  ng/mL). On applying the unpaired Student's t-test, it was found that serum vitamin D levels in the case group and control group were statistically extremely significant at  $p < 0.0001$ .

### DISCUSSION

The purpose of the present study was to explore the influence of physical activity on serum vitamin D level.



Graph 1: Gender distribution according to vitamin D grading

Table 2: Vitamin D levels in cases and controls

	Case	Control	t-value	p-value
Mean	23.0	10.5	5.4	<0.0001 S
SD	15.3	7.1		

S: Significant

The present study is a case-control study comparing the serum vitamin D levels in physically active subjects as compared with comparatively physically underactive controls. The literature contains many reports on serum levels of 25(OH)D3 in individuals from various sport disciplines vs individuals with a low level of physical activity.

These studies were largely inconclusive. A study in a group of bodybuilders showed higher levels of 25(OH)D3 compared with the control group.<sup>5</sup> Similar results were obtained by Zittermann,<sup>6</sup> who compared sportspersons of various disciplines (triathletes, play sports, and track and field sports) with individuals leading a sedentary lifestyle.

On the contrary, a study conducted by Maïmoun et al<sup>7</sup> in cyclists and swimmers did not show elevated levels of 25(OH)D3. In our study, we found that the mean serum vitamin D level was significantly elevated in subjects participating in physical activity as compared with those having comparatively sedentary lifestyle. This finding is similar to the other studies done in different parts of the world.

Many studies have documented the relationship between physical activity and serum vitamin D levels. Elevation in serum vitamin D level is independently regulated by the physical activity of the individual.<sup>5,8-10</sup> It is well established that physical activity increases local bone mass, reduces calcium excretion, and raises absorption efficiency,<sup>11</sup> thus increasing serum calcium that results in sparing serum vitamin D.

In addition, physical activity which is known to reduce body weight by increasing the rate of lipolysis may enhance mobilization from adipose tissue, thus increasing its serum level.<sup>12-15</sup> In our study population, vitamin D

deficiency was widely prevalent among healthy young individuals. It should be emphasized that only 25.4% (n = 16) of our cases had normal levels of 25(OH)D3, while 20.6% (n = 13) were vitamin D insufficient and 52.4% (n = 33) were vitamin D deficient.

In the control group, only 4% (n = 2) of the subjects had normal levels of 25(OH)D3, with 4% (n = 2) being vitamin D insufficient and 92% (n = 46) vitamin D deficient. In our study, the normal range for serum levels of 25(OH)D3 was defined as 30 to 70 ng/mL (75–150 nmol/L), vitamin D insufficiency was defined as serum levels of 20.1 to 29.9 ng/mL (50.1–74.9 nmol/L), and vitamin D deficiency as serum levels below 20 ng/mL (50 nmol/L).<sup>4</sup>

A study in Qatar’s professional football league players showed that only 15.8% of the subjects had 25(OH)D3 levels above 75 nmol/L (30 ng/mL), 28.7% were vitamin D insufficient, and 55.6% deficient. Although they train and play in a geographical region heavily exposed to sunlight, the players still have 25(OH)D3 deficiency.

The authors suggest that this might be due to the fact that due to the high temperatures during the day, the players most often train after the sunset. According to Hamilton et al,<sup>16</sup> factors that determine serum levels of 25(OH)D3 may include the skin color, use of sun protection cosmetics, and the geographic region from which the players originate. Our results are consistent with those of Bell et al,<sup>5</sup> who conducted a study in representatives of strength disciplines.

Maïmoun and Sultan<sup>17</sup> suggest that the level of physical activity may indirectly affect the levels of parathyroid hormone (PTH) and 25(OH)D3 levels, as the exercise stimulus causes serum levels of phosphate and calcium to decrease, which results in increased secretion of PTH that may finally lead to increased renal synthesis of calcitriol. In our study, the values of serum vitamin D level in females are lower than the males, which is consistent

with the findings of other similar studies in which women tended to have lower values.<sup>18</sup> Our study acknowledges a few limitations.

First, the data on physical activity were based on administered questionnaires which are subjected to recall bias. A prospective approach using a more controlled environment (experimental setting) rather than interview questionnaire might provide more definitive answers to the differences observed in the present study.

Second, the present study needs to be pursued on a larger study population to allow us to identify more parameters that influence the serum vitamin D levels. Lastly, serum parathormone was not assessed in this study and is still subject of debate whether vitamin D supplementation should be given to the deficient subjects, in the absence of information on biological consequences and nonavailability of serum parathormone level.

## CONCLUSION

The following conclusions were drawn from the study:

(1) In the case group (apparently healthy and physically active young individuals), the mean of serum vitamin D level was higher (23 ng/dL) than the control group (apparently healthy young individuals) (10.5 ng/dL). Case group and control group were significantly and very sensitively separated even in very narrow spectral difference in exercise levels. (2) Serum vitamin D deficiency was prevalent even in apparently healthy young individuals. (3) Serum vitamin D deficiency was more prevalent in females. From these findings we can conclude that serum vitamin D levels are a possible function of the extent of physical activity.

In conclusion, vitamin D deficiency is very common among apparently healthy young adults, as found in the present study. The serum vitamin D level is influenced by their level of physical activity.

## CLINICAL SIGNIFICANCE

This study clearly shows that the increased physical activity, especially in sunlight, among individuals should be encouraged, not only at home but also at their school and workplace to promote a more active lifestyle that will counteract not only vitamin D deficiency but also conditions, such as obesity, metabolic syndrome, diabetes, and cardiovascular diseases.

Appropriate information regarding the importance of physical activity needs to be dissipated in schools, colleges, offices, and through the media. Vitamin D supplementation in vulnerable groups, especially in those leading a sedentary lifestyle and the elderly, is also suggested but needs further studies, particularly by correlating with the parathormone levels.

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