

International Journal of Medical Science and Current Research (IJMSCR) Available online at: www.ijmscr.com Volume 4, Issue 5, Page No: 191-197 September-October 2021



## Does physical activity and life style have a role in vitamin- D requirement of young healthy individuals?

<sup>1</sup>Dr Pavan Pradhan, <sup>2</sup>Dr Surender Kumar, <sup>3</sup>Dr Brijesh Chauhan, <sup>4</sup>Dr Vikas Saxena, <sup>5</sup>Dr Sandeep Singh, <sup>6</sup>Dr Shaila Mishra

MS orthopaedics,

<sup>1</sup>Professor & Head, <sup>2</sup>Assistant Professor, <sup>3,5</sup>Senior Resident, <sup>4</sup>Associate Professor, <sup>6</sup>Professor
<sup>1,3,5</sup>Orthopaedics B R D Medical College, Gorakhpur, UP
<sup>4</sup>Orthopedics, Government Institute of Medical Sciences, Greater Noida, UP
<sup>6</sup> Pathology, B R D Medical College, Gorakhpur, UP

\*Corresponding Author: Dr Vikas Saxena

Associate Professor, Orthopaedics, Government Institute of Medical Sciences, Greater Noida, UP

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

### Abstract

**Background:** The deficiency of vitamin D is considered as pandemic. Certain individuals including medical graduates may have a high predisposition for developing Hypovitaminosis D as the majority of time is spent indoors. The present study was conducted to compare the vitamin D status in healthy young adults of two diagonally different professions (medical graduates and para-military recruits) and to validate its relationship with parathormone (PTH) in determining vitamin D requirement.

**Material and methods:** We conducted a questionnaire based cross sectional study, to assess daily dietary habits, food consumption, daily sun exposure on 107 medical students (predominantly indoor healthy population) and 107 paramilitary recruits (predominantly outdoor healthy population) who were on controlled diet and life style and measured their serum Vit D3, serum calcium and serum Parathormone level (PTH).

**Result:** In our study 102 out of 107 [95.32%] MG and 85 out of 107 [79.4 %] PM recruits, were found to be Vitamin-D deficient. Out of which 65 [60.7 %] MG and 18 [16.8 %] PM recruits have severe hypovitaminosis D i.e. [Serum Vit D <10 ng/ml. Only 1 MG and 4 PM recruits were found to have sufficient level [ $\geq$  30 ng/ml].

**Conclusion**: The mean serum Vit  $D_3$  level in MG group was 10.4 ng/ml and in PM recruits, mean was 16.9 ng/ml. This mean Vit  $D_3$  level of 16.9 ng/ml in PM recruits can be considered as adequate for Indian population as they were on controlled dietary support, adequate sun light exposure and exercise. Inverse relationship of Vitamin D3 with PTH was found statistically significant and should be considered while determining the vit D status of a population.

**Keywords**: Medical students (MG), Paramilitary (PM) recruits, Serum 25 hydroxy Vitamin D3 (Vit D3), serum parathormone (PTH) level

### INTRODUCTION

Vitamin-D has been traditionally known as antirachitic factor or sunshine vitamin or kidney hormone. It is unique nutrient because it can be synthesized endogenously (in skin) and works as hormone<sup>1</sup>. It is a fat-soluble vitamin, and it is very important factor for calcium homeostasis and bone mineral metabolism. Vitamin D deficiency/ insufficiency is now debated as a pandemic, even in equatorial region, where ultraviolet rays are assumed to be adequate. After a careful review of available literature, Institute of Medicine (2011), concluded that Vit D<sub>3</sub> levels of 16 ng/ml (40 nmol/litre) cover the requirements of approximately half the population, and levels of 20 ng/ml (50 nmol/litre) cover the requirements of at least 97.5% of the population<sup>2</sup>.

The Society of Endocrinology and Metabolism, Turkey (2018), defined reference Vit D3 level (< 20 ng/ml as deficient, 21-29 ng/ml as insufficient, 30ng/ml and above as sufficient)<sup>3</sup>. As per above guide lines, over a billion people across the globe have low vitamin D<sub>3</sub> level irrespective of age and ethnicity<sup>4-8</sup>. Even Indian scenario is not much different and deficiency is estimated around 70-100% in the general population<sup>9-10</sup>.

Sun exposure is one of the best natural sources for prevention and treatment of Vit D<sub>3</sub> deficiency. Our diet also provides small amount of vitamin D. A person's vitamin D<sub>3</sub> level can be affected by latitude (distance from equator), use of sunscreen, outdoor activity and skin pigmentation. Serum Vit D3 is most commonly used parameter for assessment and is the major circulatory metabolite of Vitamin D<sup>11,12.</sup> Inverse relationship of serum 25(OH) vit D3 level and serum PTH is well established in many studies <sup>13-15.</sup> Therefore, the serum PTH concentration, in conjunction with serum 25(OH) vit D3, has been proven to be a valuable indicator of vitamin D status. The present study was conducted to establish the normal range of the vitamin D level among north Indian healthy young adults. This is in consideration of the fact that decreased vit D3 level will lead to decreased serum calcium and raised serum PTH level.

### MATERIAL AND METHODS

The present study included 107 MG, representing normal adult healthy Indian population, and 107 young PM recruits considered as ideal population with best physical fitness, of comparable age group (19 -27 years). The PM recruits were having good daily sun light exposures and were on controlled diet. Persons with any liver disease, renal disease, malignancy, metabolic bone disease and on medication were excluded. Individual with any musculoskeletal problems and on vitamin D/calcium supplementation in the last 3 months were also excluded. All the participants were investigated for Serum 25 hydroxy vit D<sub>3</sub> level and serum parathyroid hormone level (PTH). Age (in years), height (cm), weight (kg), and body mass index (BMI) kg/m<sup>2</sup> were recorded for all participants. A questionnaire was used to assess daily dietary habits, egg and fish consumption, sun exposure (hours per day).

The blood levels of vitamin D were interpreted as per the society of Endocrinology and Metabolism, Turkey (2018) guide lines<sup>3</sup>. The association between the categorical variables and hypovitaminosis D was examined using Chi-Square test. The mean vitamin D levels among medical undergraduates and paramilitary recruits were compared using independent sample ttest. A probability value (p values) of <0.05 was considered statistically significant.

#### RESULTS

This cross-sectional study was conducted on 214 participants, out of which 107 participants were medical undergraduates and 107 participants were paramilitary recruits. All eligible participants were of aged group 19-27 (23±2) years. Sixty-nine (64.5 %) MG and 77 (72.0 %) PM recruits were of normal BMI range (20-25). Twelve (11.2 %) MG were under weight. Twenty-six (24.3 %) MG and 31 (29.0 %) PM recruits were overweight. None of the PM recruit was under weight. Sixty (56.1 %) MG were exposed to sunlight for < 30 minutes/day while 47 (43.9 %) were having sun exposure for >30 minutes /day. Among PM recruits, all 100% were exposed to sunlight for >30 minutes /day. Among MG, 82 (76.6 %) were consuming egg  $\geq$ 2 serving/ week and 77 (72.0 %) were consuming fish /chicken  $\geq 2$  serving/week. Among PM recruits, 92 (85.98%) were consuming both egg and fish /chicken > 2 serving/week.

As per Endocrine Society Guidelines (2018), 102 (95.3 %) MG & 85 (79.4 %) PM recruits, were found to be Vitamin-D deficient. Out of them 65 (60.7 %) MG and 18 (16.8 %) PM recruits were having severe Vitamin D deficiency [vit D3 <10 ng/ml]. Thirtyseven [34.6 %] MG and 67 [62.6 %] PM recruits had moderate deficiency [serum 25(OH) vit D3 level,10-20 ng/ml]. Only 1 MG and 4 PM recruits were found to have sufficient level [vit D3 level  $\geq$  30 ng/ml]. (**Table 1**)

Vitamin D <sub>3</sub> (ng/ml)	Medical undergraduate [N=107]	paramilitary recruits [N=107]	<sub>se</sub> 192
Serum 25(OH)	No. of	No. of	

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<10	65	18
10-20	37	67
21-29	4	20
≥30	1	2

### Table 1. Distribution of Serum 25(OH) Vitamin D3Level

In our study, Mean vit D3 level in MG group was  $10.39\pm3.46$  ng/ml as compared to  $16.96\pm5.73$  in PM group. Median vit D3 levels were 8.5 ng/ml and 16.2 ng/ml in MG and PM group respectively.

Twelve [11.2%] MG were found to have serum PTH Level <11 pg/ml and 77 (71.9%) MG have PTH level between 11-68.3 pg/ml and 18 MG (16.82%) had PTH >68.3 pg/ml. Among PM recruits 68 (63.55%) were found to have serum PTH level 11-68.3pg/ml and 39 (36.35%) with serum PTH >68.3 pg/ml. Serum PTH Level < 11 pg/ml was not found in any recruit. (**Table 2**)

	Vitamin D3 Level (ng/ml)					
	Medical PM All					
	Graduates	Recruits	Subjects			
Mean ± SD	10.39±3.46	16.96±5.73	13.66			
Median	8.5	16.20	12.5			

### Table 2. Vit D level in medical graduates (MG) andparamilitary recruits (PM)

Thirty-six PM recruits, with Vit D<sub>3</sub> Level  $\leq 20$  ng/ml, were found with serum PTH level >68.3 pg/ml and 11 [10.20 %] recruits with vit D3 between 21-29 ng/ml, were found with serum PTH level 11-68.3pg/ml. One

Volume 4, Issue 5; September-October 2021; Page No 191-197 © 2021 IJMSCR. All Rights Reserved PM recruit, whose vit  $D_3 \ge 30$  ng/ml, had serum PTH level between 11-68.3 pg/ml. (**Table 4**) We observed that in PM recruits, most individual with low serum vitamin  $D_3$  have higher serum PTH level.

Serum	No. of medical	No.	of
parathyroid	graduates	paramilitary	
[pg/ml]	[N=107]	recruits	
		[N=107]	
<11	12	0	
11-68.3	77	68	
>68.3	18	39	

Table 3. Distribution of participants according toserum parathyroid level

SERU	SERU	%	SERU	%	SERU	%
Μ	Μ		Μ		Μ	
VITA	PTH<		РТН		PTH>6	
MIN	11		11-		8.3	
D	PG/D		68.3		PG/DL	
[NG/M	L		PG/D			
L]			L			
≤20	0	0	56	52.	36	33.
				33		64

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21-29	0	0	11	10.	3	2.8
				20		0
≥30	0	0	1	0.9	0	
				3		

## Table 4. Distribution of paramilitary recruitsaccording to serum vitamin D and serumparathyroid level

We observed that among MG with low Vit D3 [<20 ng/ml], Twelve (11.21%) MG had serum PTH level <11 pg/ml, 73 (68.22%) MG had PTH level within normal range. Only 18 (16.82%) MG with serum vitamin D3 < 20 ng/ml had raised PTH level. (**Table 5**)

SERU	SER	%	SER	%	SERU	%
Μ	UM		UM		Μ	
VITA	РТН		РТН		PTH>	
MIN D	<11		11-		68.3	
NG/M	PG/		68.3		PG/M	
L	ML		PG/		L	
			ML			
≤20	12	11.	73	68.	18	16.
		21		22		82
21-29	0		3	2.8	0	0
				0		
≥30	0		1		0	0

# Table 5. The Distribution of medical studentsaccording to serum vitamin D and serumparathyroid level

Linear regression done for adjusted estimates shows that there is significant inverse relationship between PTH levels and Vit D3 levels (p value = 0.004) while the levels of VitD3 are significantly higher for individuals belonging to the PM personnel compared to the MG (p value = 0.001). Age or Calcium levels in serum were not significantly associated with the VitD3 levels in our study. (**Table 6**)

Variable	Standardiz ed Coefficien ts	Level of	95.0% Confidence Interval	
variable	Beta	Significan ce	Low er Boun d	Uppe r Boun d
(Constant )		0.223	-32.6	7.66 3
Age	0.117	0.175	- 0.26 7	1.45 9
Cal (mg/ml)	0.1	0.125	- 0.19 4	1.58 6
PTH (pg/ml)	-0.2	0.004	- 0.10 4	-0.02
Designati on	0.288	0.001	2.54 8	9.17 2

Table 6. Linear regression analysis correlatingserum vit D3 levels with age, serum calcium, serumPTH and designation (MG and SSB recruits)

### DISCUSSION

India is a vast tropical country extending from 8.4°N latitude to 37.6° N latitude. Majority of its population lives in areas receiving ample sunlight throughout the year and hence there was a disbelief that Vitamin D deficiency is uncommon in India <sup>16,17</sup>. Vitamin D<sub>3</sub> is a fat-soluble vitamin, synthesised predominantly in skin. The central role of hormonal 1, 25-dihydroxyvitamin D<sub>3</sub> [1,25(OH)2 D<sub>3</sub>] is to regulate calcium and phosphorus homeostasis via actions on intestine, kidney and bone<sup>18</sup>. It also stimulates intestinal phosphate absorption, suppression of parathyroid

hormone (PTH) and regulation of osteoblast function. Recently vit D status is being strongly also linked to autoimmune disorders<sup>19</sup> (Crohn's disease, multiple sclerosis, rheumatoid arthritis and type 1 diabetes mellitus), infection and risk of developing cancer colon, prostate<sup>20.</sup> This has increased the interest regarding Vit-D levels in various population and increasing number of patients are being screened and being treated to maintain adequate level of Vit D3 (>30 mg/dl).

According Endocrine Society (2018)to recommendation<sup>3</sup>, we found 102 [95.3 2 %] MG and 85 [79.43 %] PM recruits, to be Vit-D deficient. Similar finding was found in a study conducted by P Aparna in 2018<sup>21</sup>. Because the PM recruits were on control diet and adequate sun exposure, prevalence of severe vit D deficiency [<10 ng/ml] is lower, among PM recruits compared to MG. The number of participants in moderate deficiency level (11-20ng/ml) were higher in PM recruits (67) in comparison to MG (37), without any clinical symptoms or signs and could perform strenuous physical activities. It suggests that this range of vit D may be normal for this population. Insufficiency level of vit D (21-29 ng/ml) was found in 4 [3.73%] MG and 20 [18.69 %] PM participants. Although most of the participants have insufficient vit D levels, <20 ng/ml, study participants were healthy and not having any symptoms.

The mean value of serum Vit D3 (16.90 ng/ml) among PM recruits, though is considered as deficiency as per Endocrine society guidelines, but this serum concentration as per IOM (2011) covers the requirement of approximately half the population and hence considered adequate.

According to Manson et al<sup>22</sup>, a common misconception is that, if the Recommended daily allowance functions as a "cut point", nearly the entire population must have a Vit D3 level above 20 ng/ml to achieve good bone health. However, the reality is that the majority (about 97.5%) of the population has a maintained serum level of 20 ng/ml or less. Moreover, by definition of an average requirement. approximately half the population has a requirement of 16 ng/ml (Estimated average requirement) or less. These findings validated our mean value of Vit D3 16.91 ± 5.73 ng/ml for healthy PM recruits with controlled diet, sun exposure and strenuous physical activity.

Canan Gönen Aydın et al reported that Vit D3 target of 40 ng/mL is recommended for athletes, because at this level vit D3 begins to be stored in the muscle and fat for future use. Furthermore, at levels below 32 ng/mL, vitamin D is not likely to be readily available for the advanced processes involved in the autocrine pathways, which is the pathway that is most likely to influence performance. This amount can be utilized whenever necessary<sup>3</sup>. The Same study concluded performance of the muscles is impaired if the level of vitamin D falls below 32 ng/mL. Contrary to this, in our study, PM recruits were taken as ideal adult healthy population on healthy diet with adequate sun exposure and have mean value of vitamin D3  $16.91 \pm 5.73$  ng/ml and they were having no musculoskeletal problem and were undertaking `regular strenuous physical activity. In our study, we have not investigated for storage of vit D3 in muscle and fat so we can't comment on the status of vit D3 in muscles of SSB recruits.

Though several published studies suggest that levels of parathyroid hormone rise when levels of 25(OH)D fall <30 ng/mL, this assumption is controversial. The relationship of PTH and 25(OH)D is not curvilinear, and data indicate that there is discordance between studies about PTH levels when 25(OH)D levels are between 20 and 30 ng/ml. In fact, no absolute threshold level of serum 25(OH)D is evident at which the serum level of PTH levels starts rising<sup>23</sup>. Other investigators have tried to define insufficiency states on the basis of possible inflection point at which serum PTH starts to rise with falling levels of 25(OH)D (secondary hyperparathyroidism), a less conspicuous inflection point was found at 32 ng/mL (95% CI, 27-36), which reasonably corroborates with the current cut off of definition of vitamin D sufficiency, and the second, steeper inflection point was found at 16.5 ng/ml (95% CI, 14.9-18.8) which corroborates with the IOM supported EAR linked value of 25(OH)D level in general population and possible definition of vitamin D deficiency.<sup>24</sup> In our study, MG have the mean vitamin D3 level of 10.39±3.46 ng/ml. 65 out of 107 MG have severe vitamin D deficiency, 37 out of 107 MG have moderate vitamin D deficiency, so in total 102 out of 107 have vitamin D deficiency. In PM recruit group, 18 out of 107 have severe vit D deficiency and 67 out of 107 have moderate deficiency, in total 85 out of 107 have vitamin D deficiency according to the Endocrine society guidelines. This should lead to increase in serum PTH levels according

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to the available literature<sup>16</sup>. However, in our study only 18 medical graduate and 39 military recruits have shown rise in PTH levels of > 68 pg/ml and rest of the participants do not show any rise, that suggest mean value of vit d3 of  $10.39\pm3.46$  in MG and  $16.91\pm5.73$ in PM recruits (control population) is adequate to maintain the serum calcium levels and other physiological functions. Marwaha et al <sup>25</sup> also concluded absence of an anticipated PTH response to low serum 25(OH)D levels in half of the participants. Our study exhibited statistically significant inverse relationship between serum vitamin D3 and PTH levels in the combined analysis of vit D level in MG and PM groups.

There is still paucity of data to draw any meaningful consensus on the cut-off value of serum vit D3 levels in reference to serum PTH levels that can validate the vit D3 status in a population.

This study suggests to carry out the study in large population to establish a new inflection point for the screening of population for the vit D3 status. This study also suggests to perform both Vitamin D3 and PTH to evaluate patient's vitamin D3 status, instead of testing only serum vit D3 level. Vit D3 levels are influenced by the level of physical activity and sun exposure and it seems that the level of physical activity also influences the infliction point. Small sample size and non-estimation of status of vit d3 in muscle of SSB recruits are limitation of our study.

As PM recruits represent active adult healthy population with adequate sun exposure. Their Vit D3 level of  $16.90 \pm 2$  SD can be considered as the standard for Indian population as is also recommended by IOM 2011. We have not found any evidence of decrease in the athletic performance of recruits as was predicted by others but it needs further investigations.

**Conclusion:** This study suggests life style and activity level of young healthy individuals influence the vit D infliction point, and adequacy of vit D level for an individual should be decided in combination of raised PTH level. It also suggests that vit D3 level of adult healthy Indian population is close to reference recommendation as per Institute of Medicine 2011.

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