

## Vitamin D status in Bangladeshi subjects: a laboratory based study

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### Abstract

**Background:** Vitamin D plays important role in normal functioning of multiple organs of the body. Hypovitaminosis D is known to be prevalent worldwide including the tropical countries. The present study was carried out to evaluate the vitamin D status in Bangladeshi patients undergoing laboratory investigation for vitamin D.

**Methods:** This was a laboratory-based study. Data were extracted from the database of a diagnostic centre of Dhaka city and were analysed. Vitamin D status was defined as follows: deficiency 0 to <20 ng/ml, insufficiency 20 to <30 ng/ml, sufficiency 30-100 ng/ml and potential toxicity >100 ng/ml.

**Results:** A total of 793 plasma vitamin D level reports were analysed. Out of 793 subjects, 269 (33.9%) were male and 524 (66.1%) were female. Majority (62.0%) were between 21 and 60 years of age. Mean (+/- standard deviation) vitamin D level of the study subjects was 21.66 (+/- 18.63) ng/ml. Eighty-six percent had hypovitaminosis D; 61.4% had deficiency and 24.1% had insufficiency. Vitamin D level was found sufficient in 13.1% subjects. Among the deficient subjects, 31.6% were male and 68.4% were female; among the insufficient subjects, 35.1% were male and 64.9% were female. Sixty-eight percent of the deficient subjects belonged to the 21 to 60 year age group, whereas 57.1% of the insufficient subjects were between 21 and 60 years.

**Conclusion:** Hypovitaminosis D is common among the real-world clinical subjects undergoing vitamin D estimation in Bangladesh. Middle-aged females are more likely to be affected.

**Keywords:** Bangladesh, cholecalciferol, prevalence, vitamin D deficiency.

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### Introduction

Vitamin D, also known as the sunshine vitamin, is an important molecule which plays crucial role in human body. Beyond its well-recognized effects on musculo-skeletal system, this vitamin is now known to exert gene-mediated pleotropic effect on a wide range of extra-skeletal tissues. In fact, vitamin D receptors are present in the nuclei of almost all types of nucleated cells to which calcitriol, the active form of vitamin D binds and gets involved in regulation of gene activity.<sup>1</sup> Observational studies have suggested an inverse association between vitamin D status and risk of developing a number of diseases including type 1 diabetes mellitus, cardiovascular disease, certain cancers, cognitive decline, depression, pregnancy complications, autoimmunity, allergy and even frailty.<sup>2-5</sup> Results from randomized controlled trials (RCTs) and meta-analyses of RCTs do, however, only provide limited support for such effects.<sup>6</sup> Vitamin D deficiency is pandemic, affecting both temperate and tropical countries; almost half of the world's population has got hypovitaminosis D.<sup>7-9</sup> Like elsewhere, vitamin D deficiency is highly prevalent in south Asian countries.<sup>10</sup>

According to a recently published review, the prevalence of vitamin D deficiency in India ranged from 40% to 99%, with most of the studies reporting a prevalence of 80%-90%.<sup>11</sup> Data regarding vitamin D status in Bangladesh are scarce and is derived from small cross-sectional studies involving specific class of people e.g., diabetic patients, women and doctors in a tertiary care hospital of Dhaka City.<sup>12-18</sup> The National Micronutrient Survey 2011-12 provided nationally representative data on vitamin D status, but only in pre-school children, school-age children and non-pregnant, non-lactating women.<sup>19</sup> All these data lack generalizability. The present study was planned to determine the vitamin D level among the subjects for whom laboratory analysis of serum vitamin D level was sought.

### Methods

This retrospective, laboratory-based, observational study was carried out from January 2015 to May 2017 in the Department of Pathology of a diagnostic centre of Dhaka City. Data were extracted from the database. All the patients who were referred to the centre for vitamin D estimation during the study period were purposively included. During the study period, 793 subjects presented for vitamin D investigation. For each subject, three ml blood was collected in gel tubes and serum was separated via centrifugation at 4,000 rpm for 5 minutes. The immunodiagnostic enzyme linked immunosorbent assay (ELISA) was used for quantitative determination of the 25(OH)D in serum and plasma. The assay utilizes a competitive ELISA technique with a selected monoclonal antibody recognizing 25(OH)D. Vitamin D status was defined as follows: deficiency 0 to <20 ng/ml, insufficiency 20-<30 ng/ml, sufficiency 30-100 ng/ml, potential toxicity >100 ng/ml.

Data were analyzed by using statistical package for social scientists (SPSS) (version 16) for Windows (spss16-t2). Descriptive statistics was applied to calculate frequency and percentages from categorical variables and mean and standard deviation were measured from continuous numerical variables. For comparing proportions between different groups, chi-square tests of significance were done.

### Results

A total of 793 plasma vitamin D level reports were analysed. Out of 793 subjects, 269 (33.9%) were male and 524 (66.1%) were female (Table I).

**Table I** Distribution of subjects by sex, age and serum 25(OH)D status (N=793)

Variable	Frequency	Percentage
<b>Gender</b>		
Male	269	33.9
Female	524	66.1
Total	793	100.0
<b>Age (years)</b>		
0-20	138	17.4
21-40	236	29.8
41-60	255	32.2
>60	164	20.7
Total	793	100.0
<b>S. 25(OH)D status</b>		
Deficient	487	61.4
Insufficient	191	24.1
Sufficient	104	13.1
Potentially toxic	11	1.4
Total	793	100.0

[25(OH)D=25 hydroxy cholecalciferol]

Majority (62.0%) were between 21 and 60 years of age. Mean vitamin D level of the study subjects was 21.66 ng/ml (standard deviation 18.63). Eighty-six percent had hypovitaminosis D, 61.4% had deficiency and 24.1% had insufficiency. Vitamin D level was found sufficient in 13.1% subjects. Eleven persons out of 793 were having potential toxic level of serum 25(OH)D (>100 ng/mL). Among the deficient subjects, 31.6% were male and 68.4% were female; among the insufficient subjects, 35.1% were male and 64.9% were female (Table II). There was no statistically significant difference of the distribution of sex across different categories of vitamin D status ( $p=0.207$ ). In terms of age distribution by vitamin D status, 68.2% of the deficient subjects belonged to the 21 to 60 year age group, whereas 57.1% of the insufficient subjects aged between 21 and 60 years (Table III).

**Table II** Distribution of subjects by sex and vitamin D status (N=793)

			Vitamin D status				Total	P value
			Deficient	Insufficient	Sufficient	Potential toxicity		
sex	Male	Count	154	67	44	4	269	0.207
		% within sex	31.6%	35.1%	42.3%	36.3%	33.9%	
	Female	Count	333	124	60	7	524	
		% within sex	68.4%	64.9%	57.7%	63.6%	66.1%	
	Total	Count	487	191	104	11	793	
		% within sex	100.0%	100.0%	100.0%	100.0%	100.0%	

**Table III** Distribution of subjects by age group and vitamin D status (N=793)

Age(years)	Vitamin D status (ng/ml)				Total
	Deficient	Insufficient	Sufficient	Potentially toxic	
0-20	76	33	24	5	138
	15.6%	17.3%	23.1%	45.5%	17.4%
21-40	171	41	22	2	236
	35.1%	21.5%	21.2%	18.2%	29.8%
41-60	161	68	24	2	255
	33.1%	35.6%	23.1%	18.2%	32.2%
>60	79	49	34	2	164
	16.2%	25.7%	32.7%	18.2%	20.7%
Total	487	191	104	11	793
	100.0%	100.0%	100.0%	100.0%	100.0%

## Discussion

The present study was a retrospective analysis of data involving people from different socio-economic background and of different age groups and both sexes. Similar lab data-based study was carried out in neighbouring countries like India, Pakistan and Saudi Arabia.<sup>20-23</sup> Prevalence of hypovitaminosis D [serum 25(OH)D <30 ng/mL] was 85.5% in the present study; 61.4% had deficiency (serum 25(OH)D <20 ng/mL) whereas 24.1% had insufficiency (serum 25(OH)D 20-29.9 ng/mL). Vitamin D level was found sufficient in 13.1% subjects only.

The study involving 26,346 subjects coming for executive health check-up in Gurgaon, India revealed hypovitaminosis D, defined as serum 25(OH)D <40 ng/mL in 93% of the study subjects; vitamin D deficiency

(serum 25(OH)D <20 ng/mL) was found in 59%.<sup>20</sup> Similar large study from Pakistan involving 60,937 specimens revealed prevalence of vitamin D deficiency, defined as serum 25(OH)D <20 ng/mL to be 66.1%.<sup>21</sup> Smaller study with identical design found the prevalence of vitamin D deficiency (<20 ng/mL) and insufficiency (20-29.9 ng/mL) to be 60% and 27.6%, respectively.<sup>22</sup> So, the prevalence of hypovitaminosis D is more or less similar in the three Asian countries i.e., Bangladesh, India and Pakistan.

In the present study, mean serum 25(OH)D level of the study subjects was 21.66 ng/mL which is almost similar to the mean value of 21.4 ng/mL in the Indian study.<sup>20</sup> On the other hand, the median 25(OH)D level was 13.5 ng/mL in the study from Pakistan which is lower than the values obtained in the present study.<sup>21</sup>

In the present study, females were more severely affected by hypovitaminosis D than the males, however the differences were not statistically significant. In the Indian study, there was significant differences in mean serum 25(OH)D levels between male and female subjects.<sup>20</sup> However, Kiani et al. did not find such differences.<sup>22</sup>

Despite paucity of data, such high prevalence of vitamin D deficiency was found in previous studies in Bangladesh. In 2001, hypovitaminosis D, defined as serum 25(OH)D  $\leq 15$  ng/mL was observed in 50% of subjects in low socio-economic group and 38% of subjects in high socio-economic group, respectively.<sup>13</sup> In another study, the prevalence of hypovitaminosis D, defined as serum 25(OH)D  $< 16$  ng/mL was 78% in young women, 83% in veiled women and 76% in diabetic women.<sup>14</sup> The mean serum 25(OH)D was 14.68 ng/mL in a cross-sectional study involving 200 female garment workers, the value is lower than the value of mean serum 25(OH)D found in the present study.<sup>15</sup> In a more recent study, 89.8% of the physicians working in a tertiary care hospital of Dhaka City had vitamin D deficiency (serum 25(OH)D  $< 20$  ng/mL).<sup>16</sup> Among the newly diagnosed type 2 diabetic patients, the mean serum 25(OH)D level was  $27.91 \pm 2.58$  ng/mL; 30% had vitamin D deficiency defined as serum 25(OH)D  $\leq 20$  ng/mL, whereas 36% had vitamin D insufficiency with serum 25(OH)D  $> 20$  to 29.9 ng/mL, indicating better vitamin D status in these subjects in comparison to those in the present study.<sup>12</sup>

The study has got some important limitations. This was a retrospective study, based on laboratory reports only, thereby lacking details. There might be some confounding physiological and pathological factors influencing the serum vitamin D status like exposure to sun, skin complexion, dietary habits, medications. It was not possible to investigate whether patients, who were having toxic levels, were taking vitamin D or not. So, the results, in true sense, cannot be generalized. Despite these limitations, the study gives an insight regarding the high prevalence of hypovitaminosis D in a heterogenous population of Bangladeshi context. Moreover, the present study warrants carrying out well-designed cross-sectional study and nationwide survey to generate representative data on vitamin D deficiency in Bangladesh which will be an aid to formulate appropriate public health policy in future.

**Conflicts of interest:** Nothing to declare.

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