Vitamin D status in Bangladeshi subjects: a laboratory based study

Islam AKMM\textsuperscript{a}, Hasan MN\textsuperscript{b}, Rahman KM\textsuperscript{c}, Asaduzzaman M\textsuperscript{d}, Rahim MA\textsuperscript{e}, Zaman S\textsuperscript{f}, Islam MR\textsuperscript{g}, Jesmin H\textsuperscript{h}, Yeasmin L\textsuperscript{i}

Abstract

\textbf{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.

\textbf{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.

\textbf{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.

\textbf{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.

\textbf{Keywords:} Bangladesh, cholecalciferol, prevalence, vitamin D deficiency.

\textbf{(BIRDEM Med J 2019; 9(3): 202-206)}

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 musculoskeletal system, this vitamin is now known to exert gene-mediated pleotropic effect on a wide range of extraskeletal 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.\textsuperscript{1} 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.\textsuperscript{2-5} Results from randomized controlled trials (RCTs) and meta-analyses of RCTs do, however, only provide limited support for such effects.\textsuperscript{6} Vitamin D deficiency is pandemic, affecting both temperate and tropical countries; almost half of the world’s population has got hypovitaminosis D.\textsuperscript{7-9} Like elsewhere, vitamin D deficiency is highly prevalent in south Asian countries.\textsuperscript{10}
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%. 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. 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. 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 |
| Gender | | |
| Male | 269 | 33.9 |
| Female | 524 | 66.1 |
| Total | 793 | 100.0 |
| Age (years) | | |
| 0-20 | 138 | 17.4 |
| 21-40 | 236 | 29.8 |
| 41-60 | 255 | 32.2 |
| >60 | 164 | 20.7 |
| Total | 793 | 100.0 |
| S. 25(OH)D status | | |
| Deficient | 487 | 61.4 |
| Insufficient | 191 | 24.1 |
| Sufficient | 104 | 13.1 |
| Potentially toxic | 11 | 1.4 |
| Total | 793 | 100.0 |

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).
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. 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%. 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%. 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.

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. 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.

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

| Sex   | Count | Deficient | Insufficient | Sufficient | Potential toxicity | Total | P value |
|-------|-------|-----------|--------------|------------|--------------------|-------|--------|
| Male  | 154   | 67        | 44           | 4          | 269                | 0.207 |
| % within sex | 31.6% | 35.1% | 42.3% | 36.3% | 33.9% |
| Female| 333   | 124       | 60           | 7          | 524                |       |
| % within sex | 68.4% | 64.9% | 57.7% | 63.6% | 66.1% |
| Total | 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) | Deficient | Insufficient | Sufficient | Potentially toxic | Total |
|------------|-----------|--------------|------------|-------------------|-------|
| 0-20       | 76        | 33           | 24         | 5                 | 138   |
| % within age | 15.6% | 17.3% | 23.1% | 45.5% | 17.4% |
| 21-40      | 171       | 41           | 22         | 2                 | 236   |
| % within age | 35.1% | 21.5% | 21.2% | 18.2% | 29.8% |
| 41-60      | 161       | 68           | 24         | 2                 | 255   |
| % within age | 33.1% | 35.6% | 23.1% | 18.2% | 32.2% |
| >60        | 79        | 49           | 34         | 2                 | 164   |
| % within age | 16.2% | 25.7% | 32.7% | 18.2% | 20.7% |
| Total      | 487       | 191          | 104        | 11                | 793   |
| % within age | 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. 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%. 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%. 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.

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. 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.
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. However, Kiani et al. did not find such differences.

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 ≤15 ng/mL was observed in 50% of subjects in low socio-economic group and 38% of subjects in high socio-economic group, respectively. 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. 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 27.91±2.58 ng/mL in a retrospective study, based on laboratory reports only, having toxic levels, were taking vitamin D or not. So, it is 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.

**References**

1. Christakos S, Dhawan P, Verstuyf A, Verlinden L, Carmeliet G. Vitamin D. Metabolism, molecular mechanism of action, and pleiotropic effects. Physiol Rev 2016;96(1):365-408.
2. Holick MF. Vitamin D: extraskeletal health. Rheum Dis Clin North Am 2012;38(1):141-60.
3. Hossein-Nezhad A, Holick MF. Optimize dietary intake of vitamin D: an epigenetic perspective. Curr Opin Clin Nutr Metab Care 2012;15(6):567-79.
4. Smit E, Crespo CJ, Michael Y, Ramirez-Marrero FA, Brodowicz GR, Bartlett S, et al. The effect of vitamin D and frailty on mortality among non-institutionalized US older adults. Eur J Clin Nutr 2012;66(9):1024-28.
5. Holick MF. Nutrition: diabetes and D- eath D-efying vitamin D. Nat Rev Endocrinol 2012;8(7):388-90.
6. Rejnmark L, Bislev LS, Cashman KD, Eiriksdottir G, Gaksh M, Grübeler M, et al. Non-skeletal health effects of vitamin D supplementation: A systematic review on findings from meta-analyses summarizing trial data. PLoS One 2017;12(7):e0180512.
7. van Schoor N, Lips P. Global Overview of Vitamin D Status. Endocrinol Metab Clin North Am 2017;46(4):845-70.
8. Prentice A. Vitamin D deficiency: a global perspective. Nutr Rev 2008; 66:S153.
9. Holick MF. Vitamin D deficiency. N Engl J Med 2007; 357:266.
10. Akhtar S. Vitamin D status in South Asian populations - risks and opportunities. Crit Rev Food Sci Nutr 2016;56(11):1925-40.
11. Aparna P, Muthathal S, Nongkynrih B, Gupta SK. Vitamin D deficiency in India. J Family Med Prim Care 2018;7(2):324-30.
12. Alam MS, Kamrul-Hasan M, Kalam ST, Selim S, Akter F, Saifuddin M. Vitamin D Status in Newly Diagnosed Type 2 Diabetes Patients Attending in a Tertiary Hospital of Bangladesh. Mymensingh Med J 2018;27(2):362-68.
13. Islam MZ, Lambberg-Allardt C, Kärkkäinen M, Outila T, Salamatullah Q, Shamim AA. Vitamin D deficiency: A concern in premenopausal Bangladeshi women of two socio-economic groups in rural and urban region. Eur J Clin Nutr 2002;56(1):51-56.
14. Islam MZ, Akhtaruzzaman M, Lambberg-Allardt C. Hypovitaminosis D is common in both veiled and nonveiled Bangladeshi women. Asia Pac J Clin Nutr 2006;15(1):81-87.
15. Islam MZ, Shamim AA, Kemi V, Nevanlinna A, Akhtaruzzaman M, Laaksonen M, et al. Vitamin D deficiency and low bone status in adult female garment factory workers in Bangladesh. Br J Nutr 2008;99(6):1322-29.
16. Islam SS, Mollah MAG, Rahman MM, Reza MA, Hossen M, Rahman MN, et al. Evaluation of vitamin D status among doctors of a specialized hospital in Bangladesh. The Journal of Bangladesh Orthopaedic Society 2016;31(2):80-84.

17. Ahmed AKMS, Haque WMM, Uddin KN, Abrar FA, Afroz F, Huque HF, et al. Vitamin D and bone mineral density status among postmenopausal Bangladeshi women. IMC J Med Sci 2018; 12(2): 44-49.

18. Shefin SM, Qureshi NK, Nessa A, Latif ZA. Vitamin D Status among Bangladeshi Adult Muslim Females Having Diabetes and Using Hijab. BIRDEM Med J 2018;8(3):203-209.

19. National Micronutrients Status Survey 2011-12. Available at: https://static1.squarespace.com/static/56424f6ce4b0552eb7fde4e8/t/57490d3159827e39bd4d2314/1464405328062/Bangladesh_NMS_final_report_2011-12.pdf. Centre for Nutrition and Food Security, icddr,b 68, Shaheed Tajuddin Ahmed Sharani Mohakhali Dhaka, Bangladesh. UNICEF, Bangladesh BSL Building 1, Minto Road Dhaka, Bangladesh. [accessed January 1, 2019]

20. Shukla K, Sharma S, Gupta A, Raizada A, Vinayak K. Current scenario of prevalence of vitamin D deficiency in ostensibly healthy Indian population: A hospital based retrospective study. Indian J Clin Biochem 2016;31(4):452-27.

21. Hassan S, Muzammil SM, Jafri L, Khan AH. An audit of clinical laboratory data of 25 [OH]D at Aga Khan University as reflecting vitamin D deficiency in Pakistan. J Pak Med Assoc 2015;65(11):1247-50.

22. Kiani RA, Asad MJ, Abbasi S, Farooq N, Khan MU, Jamila. Prevalence of vitamin-D deficiency in urban population: A retrospective analysis. Annals of Pakistan Institute of Medical Sciences 2015;11(2): 90-94.

23. Alfawaz H, Tamim H, Alharbi S, Aljaser S, Tamimi W. Vitamin D status among patients visiting a tertiary care center in Riyadh, Saudi Arabia: a retrospective review of 3475 cases. BMC Public Health 2014;14:159.