Original Article

Vitamin D Status among the Population Visiting Jigme Dorji Wangchuck National Referral Hospital, Bhutan

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Abstract

Objective: To study the vitamin D status among the Bhutanese population visiting the Jigme Dorji Wangchuck National Referral Hospital in Thimphu, Bhutan. **Materials and Methods:** This is a retrospective descriptive study involving the extraction of data from a hospital database. Records of Bhutanese patients who had taken vitamin D tests in the last two years (2020–2021) were included in the study. **Result:** A total of 1175 individuals took the vitamin D test during the study period, and the age ranged between 1 day and 94 years. Over 60% of the participants were females. The study found that over 83% of our study population had serum vitamin D levels lower than the normal range/deficient. Around 18% of the participants had severe deficiency. **Conclusion:** The study found that most participants, including children, had vitamin D deficiency, and the finding was homogenous across gender and age groups. Further studies are required to validate these findings and identify the factors associated with vitamin D deficiency in the population for targeted public health interventions.

Keywords: Bhutan, deficiency, hospital, vitamin D

Introduction

Vitamin D is an important micro-nutrient required for the human body.[1] It plays a significant role in the regulation and expression of hundreds of genes and is identified as an essential hormone required for various physiological processes.[2-4] Vitamin D is also recognised as the missing ingredient that helps to prevent rickets in growing children.[2] The human body has receptors on all vital organs for vitamin D, including the heart, brain, bones, kidneys, and liver.[1,3] Vitamin D deficiency is associated with a number of health problems, such as various cancers, heart diseases, diabetes, infectious diseases, bone pain, depression, muscle weakness, infertility, chronic pain, backaches, and autoimmune disorders.[3]

The normal levels of vitamin D (D3-cholecalciferol is 30 ng/ml–100 ng/ml).[4,5] Vitamin D deficiency affects people of all ages, including children, adolescents, young adults, and the elderly.[3,4,6,7] Different individuals might present with different signs and symptoms,[7] and some might not exhibit any deficient symptoms. Studies found that sufficient levels of vitamin D in the body significantly reduce the risks of cancers such as prostate, colon, breast, pancreas, and lung cancers.[3,8] Musculoskeletal problems are decreased, and rates of fatal stroke, hypertension, diabetes, and cardiovascular events are also drastically reduced with sufficient levels of vitamin D in the body.[8]

Over 90% of the vitamin D we need comes from exposure to sunlight.[2,3] This transforms a cholesterol metabolite (7-dehydrocholesterol) into the vitamin D precursor.[3] Studies have reported that people living in areas greater than 37° latitude get enough exposure to sunlight.[9] However, season, latitude, time of day, skin pigmentation, ageing, and use of sunscreen lotions influence the cutaneous production of vitamin D3.[2] The body also absorbs vitamin D from naturally occurring fish oil, and individuals who do not eat enough fish or fish oil are likely to be deficient.[10] Over 90%

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Quick Response Code:

Website: https://journals.lww.com/indjem/

DOI: 10.4103/ijem.ijem_318_22

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Submitted: 15-Aug-2022 **Revised:** 29-Oct-2022
Accepted: 06-Jan-2023 **Published:** 30-Jun-2023

How to cite this article: Dhakal GP, Sharma KP, Bajgai GP, Sharma TR, Bajgai TM, Tenzin J, *et al*. Vitamin D status among the population visiting Jigme Dorji Wangchuck National Referral Hospital, Bhutan. Indian J Endocr Metab 2023;27:436-9.

of south Asians were reported to be deficient in vitamin D,[8,9] while some studies reported widespread deficiency among people living in high altitudes.[2]

Bhutan is also a high-altitude country, and there are possibilities of a high prevalence of vitamin D deficiency. However, there is no published data on vitamin D status in the population. Therefore, this study aimed to study the vitamin D levels among the population undergoing vitamin D tests at the Jigme Dorji Wangchuck National Referral Hospital, Thimphu Bhutan, and establish a baseline study for further studies.

Methodology

This is a retrospective descriptive study involving the extraction of data from a hospital database. Records of all Bhutanese patients who had taken vitamin D blood tests from 1st January 2020 to 31st December 2021 were included in the study. Vitamin D was tested using Elecsys Vitamin D total II, **cobas e** 411 analysers.

Non-Bhutanese patients were excluded from the study. Data were exported and analysed using Microsoft Excel using descriptive statistics. Results are presented as frequencies, percentages, mean and standard deviation as appropriate. Ethical approval for the study was granted by the Institutional Review Board, Khesar Gyalpo University of Medical Sciences of Bhutan.

Ethical Clearance Statement

The study was approved by Institutional Review Board, Khesar Gyalpo University of Medical Sciences of Bhutan vide IRB/Approval/Approval/PN21-034/2021-22/519 on 9 February 2022. Due to the retrospective nature of the study, the ethical committee waived consent.

Result

The study population is described in Figures 1, 2 and Table 1. Over 60% of the study population were females. The age of the study population was widely distributed and ranged from 1 day to 94 years old [Table 2]. However, around two-thirds of the participants were between the age ranges of 21 and 60 years.

Vitamin D levels by deficiency groups are presented in Table 1. Only 16.6% of the study population had vitamin D within the normal range. It was seen that close to half of the study population (44.94%) of them had serum vitamin D at a deficiency level.

The severity of deficiency by sex is presented in Table 2. The deficiency trend was similar across both sexes.

Since the age varied from day 1 to 94 years, the mean vitamin D level for each age group is also presented. Children under five years of age had the highest mean serum vitamin D levels (29 ± 23.63), while the population aged 21–30 years, 31–40 years, and 41–50 years had the least mean serum vitamin D levels [Table 3].

Table 1: Serum vitamin D Levels (*n*=1175)

Vitamin D level	Mean vit D (ng/ml)	Frequency	Percentage
Normal (≥30 ng/ml)	44±18.20	195	16.60
Insufficiency (20-29 ng/ml)	24±2.81	239	20.34
Deficiency (10-19 ng/ml)	14±2.82	528	44.94
Severe Deficiency (≤9 ng/ml)	7±1.83	213	18.12

Table 2: Severity of deficiency by sex (*n*=1175)

Deficiency levels	Female (*n*=736)		Male (*n*=439)	
	Frequency	Percent	Frequency	Percent
Normal (≥30 ng/ml)	121	16.44	74	16.86
Insufficiency (20-29 ng/ml)	133	18.07	106	24.15
Deficiency (10-19 ng/ml)	315	42.80	213	48.52
Severe Deficiency (≤9 ng/ml)	167	22.69	46	10.47

Table 3: Mean vitamin D levels by age group (*n*=1175)

Age group (years)	Mean serum vitamin D levels (ng/mL)	Frequency	Percentage
<5	29±23.63	88	7.49
5-10	25±19.02	25	2.13
11-20	19±15	89	7.57
21-30	18±12.45	185	15.74
31-40	18±10.92	228	19.40
41-50	18±11.22	223	18.98
51-60	20±17.69	159	13.53
61-70	19±10.45	85	7.23
71-80	20±9.56	47	4.00
>80	21±10.75	46	3.91

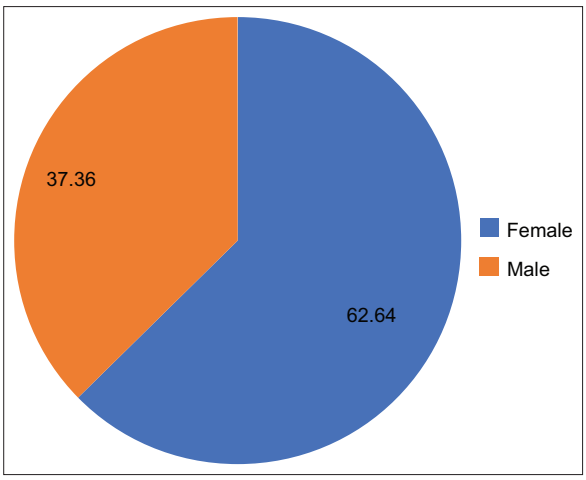

Figure 1: Gender distribution of participants

Deficiency level by age group is presented in Table 4. The deficiency levels were fairly homogeneous, with around

Table 4: Severity of deficiency by age groups (*n*=1175)

Age group (years)	Total	Normal		Insufficiency		Deficiency		Severe deficiency	
		n	%	*n*	%	*n*	%	*n*	%
<5	88	33	37.50	8	9.09	38	43.18	9	10.23
5-10	25	6	24.00	7	28.00	10	40.00	2	8.00
11-20	89	19	21.35	11	12.36	38	42.70	21	23.60
21-30	185	29	15.68	33	17.84	84	45.41	39	21.08
31-40	228	30	13.16	41	17.98	109	47.81	48	21.05
41-50	223	42	18.83	34	15.25	102	45.74	45	20.18
51-60	159	24	15.09	36	22.64	71	44.65	28	17.61
61-70	85	9	10.59	24	28.24	41	48.24	11	12.94
71-80	47	7	14.89	15	31.91	23	48.94	2	4.26
>80	46	9	19.57	15	32.61	14	30.43	8	17.39

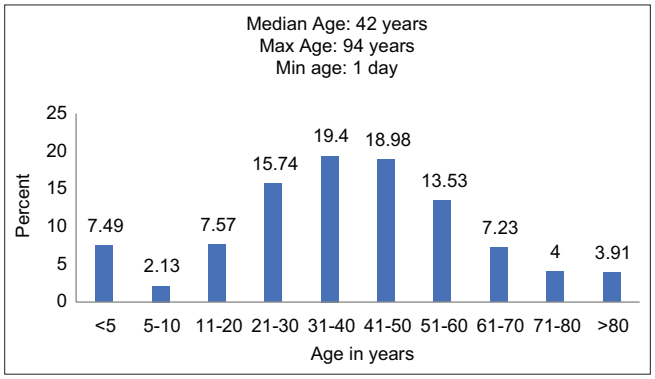

Figure 2: Age distribution of participants

one-third of the population in the deficiency category across all age groups.

Discussion

The study found a very high prevalence of vitamin D deficiency among people visiting the national referral hospital, which was fairly homogenous across gender and age groups. Fish is a major source of vitamin D in the diet.[11-13] Salmon, tuna, baby sardines and mackerel are some of the most consumed fish.[11] However, dietary diversity in Bhutan is generally poor, and the intake of such foods among the population remains poor.[14] Patients whose vitamin D levels are too low have to take vitamin D3 supplements.[9] Patients with lower levels of serum vitamin D were treated with cholecalciferol (vitamin D3) 60,000 international units (IU) weekly for six weeks, followed by a monthly dose of 60,000 IU for six months. They were also encouraged to sunbathe and eat foods from which they got vitamin D.

A study conducted in India found that over 84% of pregnant women were deficient in vitamin D,[15] while a Japanese study reported that 89.8% of pregnant women had vitamin D deficiency with seasonal variations.[16] Although vitamin D levels in women by pregnancy status could not be assessed in this study, the severe deficiency was higher in females than in males. Sun exposure levels prevent winter vitamin D deficiency in 95% of healthy white adults and 83% of adolescents, yet over 90% of healthy south Asians were seen as deficient.[9] Exposure to sunlight among Bhutanese people is minimal due to thick clothing, as the country is located in the Himalayas and is generally cold, and this could be one of the main reasons for vitamin D deficiency in the population. Population deficient in vitamin D have an increased need for oral vitamin D, although their sun exposure provides a tangible contribution and might contribute to other health benefits.[9,17]

Vitamin D production decreases with an increase in latitude as the intensity of ultraviolet (UV) rays gets reduced with an increase in latitude.[18] Owing to this, a larger dose of UV relative to erythemal UV is required to produce the same amount of vitamin D in a high-latitude location, which is evident from this study.[17,18] Air pollution is also an important factor determining the amount of solar UVB that reaches the earth's surface, and studies have reported that residents living in areas with high levels of air pollution have a higher risk of developing vitamin D deficiency.[19] Children and adolescents living in highly polluted areas are more prone to bone diseases like rickets.[20] This study had one major limitation. Since it was a hospital-based study, it does not represent the true vitamin D status of the population. Nevertheless, this is the first report on vitamin D status in Bhutan, highlighting the need for further investigations to understand the true picture of vitamin D status in the population. The study recommends conducting a nationally representative survey to understand the true picture of the vitamin D status of the Bhutanese population.

Conclusion

The study found a very high prevalence of vitamin D deficiency among the study population, which was fairly homogenous across gender and different age groups. Further studies are required to validate these findings and identify the factors associated with vitamin D deficiency in the population for targeted public health interventions.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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