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Original Research Article

Hypovitaminosis D in Healthy Health Care Professionals: A Real Deficiency or Necessity of New Reference Value for Specific Population?

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ABSTRACT:

Introduction: Vitamin D, a steroid vitamin, has attracted noticeable interest of clinicians and researchers for decades because of its diverse array of biological functions. Various studies have shown that the level of vitamin D is low in significant proportion of healthy individuals. However, indoor workers especially health care professionals are not focused, particularly in Nepal. We aimed to measure level of vitamin D in apparently healthy health care professionals. **Methods:** A descriptive cross-sectional study was carried out in apparently healthy health care professionals working at Kathmandu University Hospital in Dhulikhel, Nepal. Structured questionnaire including socio-demographics, dietary habits, and anthropometric measurements was filled in by the participants. Total serum 25-hydroxy vitamin D was measured by Chemiluminescence Immunoassay (CLIA) technique. Results were analyzed with *t-test*, *Chi-square* test, and *Pearson correlation* test. **Results:** Data from 64 female and 47 male were analyzed, mean 25-hydroxy vitamin D level was 8.81 ng/dl (*SD* = 4). Almost all (98.2%, *n* = 109) participants had vitamin D lower than normal where 72.7% (*n* = 92) were deficient, 24.5% (*n* = 17) were insufficient, and only 2.7% (*n* = 2) were having adequate level. Non-specific body pain was the only factor among all we studied that was significantly associated with vitamin D levels (*p* = 0.002). **Conclusion:** Hypovitaminosis of 25-hydroxy vitamin D was found to be very common (98.2%) in apparently healthy health care subjects of Dhulikhel Hospital. This may necessitate further research to redefine the biological reference value for our population.

Keywords: health care professionals • hypovitaminosis D • risk factors • vitamin D deficiency

INTRODUCTION:

Vitamin D is a steroidal hormone which becomes active by multiple metabolic steps. It is activated in liver into 25-hydroxyvitamin D (25-OH vitamin D) in one of the initial steps. Vitamin D is of physiological importance as it has diverse array of biological functions especially in calcium-phosphorous homeostasis. Its receptors are found in most of the tissues in human body. Major source of vitamin D is denovo synthesis (90%) in the skin from ultra violet B rays of sunlight whereas the remaining is obtained from dietary supplements.[1] Factors affecting level of vitamin D in our body are sunlight exposure, skin pigmentation, time spent indoors, dietary habits, clothing habits, sunscreen usage, sun exposure avoidance, extent of air pollution blocking UV light, and season.[2,3,4,5] During metabolism of cholesterol, conversion of 7-dehydrocholesterol to cholecalciferol in skin depends upon sunlight; its strength depends upon various environmental factors like latitude and weather conditions.[6] Thirty minutes of exposure of the skin over arms and face to sunlight without application of sunscreen, preferably between 10 AM

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to 2 PM daily, is adequate for vitamin D synthesis.[2] 25-OH vitamin D test is considered as one of the best way to monitor vitamin D levels.[7]

Research shows that vitamin D deficiency is pandemic and the major cause is lack of sunlight exposure.[1] Health care professionals are also indoor worker. There are few papers about level of vitamin D in healthcare workers and we did not find any paper published on this subject in our country, Nepal.

This study was carried out to measure the level of vitamin D in apparently healthy health care professional working at Dhulikhel Hospital and analyze the risk factors for hypovitaminosis D.

METHODS:

This was an observational, cross-sectional, analytical study conducted from March to July, 2016 in the Department of Clinical Biochemistry of Dhulikhel Hospital, Kathmandu University. Ethical clearance was obtained from institutional review committee of the hospital prior to the study. A systematic random sampling technique was used to recruit study participants. Sample size was calculated with alpha error as 0.05, power as 0.8, prevalence of hypovitaminosis D as 78%, and estimation error as 7.5%. Minimal sample size was calculated as 103 and we included 111 apparently healthy health care professionals including medical doctors, paramedics, and registered nurses. Following participants were excluded:

- Individuals suffering from chronic diseases such as:
  - Liver or renal failure/chronic renal diseases.
- Individuals under any medication in previous three months known to influence level of vitamin D such as:
  - Vitamin D supplements
  - Omega-3 fatty acid (fish oil)
  - Anticonvulsants (carbamazepine, phenytoin)
  - Steroids (prednisolone)
  - Rifampicin.
- Pregnant women
- Lactating mothers
- Post-Menopausal women
- The participants who refused to consent.

Pre-structured questionnaire was developed in English language and pre-tested in 10% of the sample size and were not included in the study. The questionnaire included socio-demography, health and dietary information, and habits of the participants. In the socio-demography section, questions were asked for participant's gender, age, and how long they have been working in the Hospital. In health information section, the participants were asked for any kind of health issues like muscle pain, headache, weakness they have experienced in last six months or any other specific pain. In the dietary information section, questions about their diet type - whether vegetarian or non-vegetarian and their daily intake of milk servings were asked. Daily milk intake was classified as one cup or less (up to 125 ml) or more than a cup (>125 ml). Moreover, questions were asked about Omega-3 fatty acid supplement, multi-supplements, smoking, and alcohol consumption. The section on sunning practices targeted participants' average length of time in minutes per day and days per week exposed to sunlight. Also, whether they mostly spent outdoors under the sun before or after noon was also asked.

Each participant was explained about the purpose of the study and consent was taken. For the biochemical parameters, overnight fasting five ml venous blood from mid-cubital vein was drawn from each individual by experienced phlebotomist using aseptic technique. Serum was separated from the blood sample by centrifugation on the same day at 4000 RPM for seven minutes. Internal quality control procedures were validated before the blood serum was analyzed by DiaSorin LIAISON 25-OH-vitamin D TOTAL Assay in Clinical Biochemistry Laboratory of Dhulikhel Hospital. Observed value of serum 25-OH vitamin D was categorized as deficient, insufficient, or optimal according to the recommendation of National Institutes of Health, Office of Dietary Supplements as shown in Table 1.[8]

All data were tabulated using Statistical Package for the Social Sciences (SPSS) software, version 23.0, for statistical analysis. Data were

Table 1: Categorization of Vitamin D according to serum 25-OH Vitamin D.[8]

Category	Serum level of 25-OH vitamin D
Deficient	< 12 ng/ml
Insufficient / Inadequate	12 to < 20 ng/ml
Adequate	20 to 50 ng/ml
Potential toxicity	> 50 ng/ml

double checked for accuracy. Each participant was assigned with unique codes for the questionnaire responses. Descriptive statistics were presented as frequency, percentages, mean and standard deviation (*SD*). Difference in mean between two groups was analyzed with independent *t-test*. Categorical data were analyzed with *Chi-square* or *Fisher-exact* test whichever was appropriate. Relationship between two scale data was analyzed with Pearson correlation test. *P* value less than 0.05 was considered significant.

RESULTS:

There were 111 participants including 47 (42.3%) male and 64 (57.7%) female. Mean age of all participants was 27.58 year (*SD* = 6.13). Mean age of male was 28.87 year (*SD* = 6.1) and female was 26.63 (*SD* = 6.03). This difference in mean age between gender was not statistically significant (t = -1.93, df =109, p = 0.56). Mean vitamin D level was 9.06 ng/ml (*SD* =4.05). Other characteristics of the participants is presented in Table 2.

Table 2: Various characteristics of the participants and their frequencies (N = 111)

Variables		*n (%)*	Cumulative percent
Profession	Paramedic	41 (36.9)	36.9
	Doctor	36 (32.4)	69.3
	Nurse	34 (30.6)	100
Diet	Non-veg	93 (83.8)	83.8
	Veg	18 (16.2)	100
Daily milk intake	Up to 1 cup (~ 125 ml)	83 (74.8)	74.8
	> 1 cup	28 (25.2)	100
Days spent under sun per week	1	40 (36)	36
	2	65 (58.6)	94.6
	3	6 (5.4)	100
Time spent under sun per day	Up to 30 min	84 (75.7)	75.7
	> 30 min	27 (24.3)	100
Part of day of sun exposure	AM	40 (36)	36
	PM	71 (64)	100
Smoking	Non-smoker	100 (90.1)	90.1
	Smoker	11 (9.9)	100
Alcohol intake	Yes	51 (45.9)	45.9
	No	60 (54.1)	100
Vitamin D level	Deficient	92 (82.9)	82.9
	Insufficient	17 (15.3)	98.2
	Adequate	2 (1.8)	100
Non-specific body pain in last six months	Yes	33 (29.7)	29.7
	No	78 (70.3)	100

Relationship between serum value of vitamin D and age was analyzed with a scatter plot (Fig 1). It showed that the level of vitamin D gradually increased with increasing age but this relationship was not statistically significant (r = 0.09, p = 0.34).

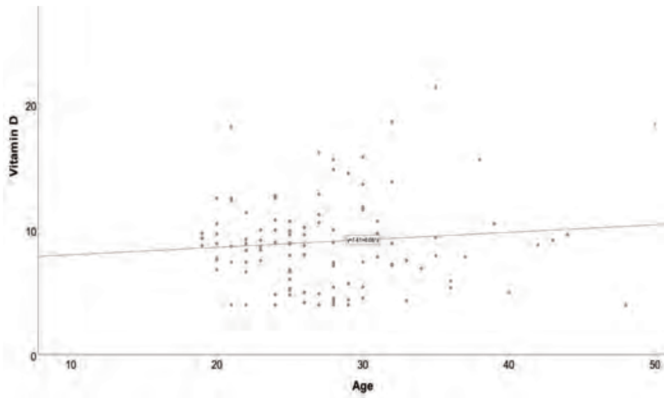

Fig 1: Scatter plot showing relationship between age and serum vitamin D.

Relationship between other characteristics of the participants and level of vitamin D is shown in Table 3. The table shows that the level of vitamin D is independent of gender, profession, diet, daily milk intake, sun exposure, smoking, and alcohol consumption. Presence of non-specific body pain in last six months was only the factor statistically associated with the level of vitamin D. On post-hoc analysis with Bonferroni correction it was found that non-specific body pain was significantly more likely to occur in participants with deficient vitamin D. Similarly, pain was significantly less likely to occur in participants with inadequate levels of vitamin D. There was no difference in presence of non-specific body pain among patients with adequate level of vitamin D.

DISCUSSION:

These results are in agreement with previous studies showing vitamin D deficiency among medical professionals. A cross sectional study by Mehrdad et al. concluded that only less than 10% of medical staffs had normal vitamin D level where 54%, 23% and 15% had severe, moderate and mild deficiency respectively.[4] Kassab et al. also reported that 78.1% had vitamin D abnormality among patients visiting primary health care center where 30.9% were deficient and 47.2% were insufficient.[9] Similarly, Al-Elq AH found that the prevalence of vitamin D deficiency was 96% and remaining had vitamin D

Table 3: Association between levels of Vitamin D and various variables (N = 111)

Variables		Vitamin D level			Statistics
		Deficient, *n* (%)	**Inadequate, *n* (%)**	**Adequate, *n* (%)**	
Gender	Female	54 (84.4)	10 (15.6)	0	$p = 0.36$*
	Male	38 (80.9)	7 (14.9)	2 (4.3)	
Profession	Paramedic	36 (87.8)	5 (12.2)	0	$p = 0.44$*
	Nurse	28 (82.4)	6 (17.6)	0	
	Doctor	28 (77.8)	6 (16.7)	2 (5.6)	
Diet	Non-veg	76 (81.7)	15 (16.1)	2 (2.2)	$p = 0.81$*
	Veg	16 (88.9)	2 (11.1)	0	
Daily milk intake	Up to 1 cup (about 125 ml)	70 (84.3)	12 (14.5)	1 (1.2)	$p = 0.56$*
	> 1 cup	22 (78.6)	5 (17.9)	1 (3.6)	
Sun exposure per day (minutes)	Up to 30	69 (82.1)	13 (15.5)	2 (2.4)	$p = 1$*
	> 30	23 (85.2)	4 (14.8)	0	
Sun exposure in AM or PM	PM	59 (83.1)	10 (14.1)	2 (2.8)	$p = 0.64$*
	AM	33 (82.5)	7 (17.5)	0	
Smoking	No	82 (82)	16 (16)	2 (2)	$p = 1$*
	Yes	10 (90.9)	1 (9.1)	0	
Alcohol intake	No	50 (83.3)	9 (15)	1 (1.7)	$p = 1$*
	Yes	42 (82.4)	8 (15.7)	1 (2)	
Non-specific pain in last six months	No	59 (75.6)#	17 (21.8)#	2 (2.6)	$p = 0.002$*
	Yes	33 (100)#	0#	0	

** = Fisher Exact; # = statistically significant*

insufficiency in medical students in Saudi Arabia.[10] According to a cross-sectional, multicenter study by Beloyartseva et al. in 2010 in 18 Indian cities, 79 % of subjects were vitamin D deficient, 15% were insufficient and 6% were sufficient.[11] Likewise, Yongyot et al. found that the prevalence of vitamin D deficiency in 217 nurses working in Royal Irrigation Hospital was 95.4%.[11]

In this study males had higher level of vitamin D compared to female but the difference was not significant. Beloyartseva et al. studied vitamin D in 2,119 medical and paramedical personnel and found that majority (79%) had deficiency and there was no significant difference of vitamin D between gender.[11] In contrast, in a cross sectional study conducted in 80 medical staff in Iran by Mehrdad et al., vitamin D deficiency was more common in women (p = 0.001).[4] Similarly, a report of systemic review of Cristina P et al. concluded that the prevalence of low vitamin D status is a global problem in all age particular in girls and women from the Middle East.[13]

We did not study the relationship between Body Mass Index (BMI) and vitamin D. Yongyot et al. found that the prevalence of vitamin D deficiency at Royal Irrigation Hospital was 95.4% in 217 volunteer nurses but it had no significant association with BMI ($p = 0.69$).[12] However, Vierucci F et al. reported five times greater hypovitaminosis D among overweight and obese adolescent Italian children than those having normal BMI ($p = 0.02$).[13] Similarly, Holick et al. stated that there is inverse association of serum vitamin D and BMI, when BMI is greater than 30 kg/m^2.[15] Obesity can be considered as one of the risk factors for vitamin D deficiency due to the presence of high quantity of subcutaneous fat in obese individual.

We did not find a significant relationship between milk intake and vitamin D. People consuming more than a cup of milk (roughly more than 125 ml) daily had slightly higher probability of having adequate vitamin D than those consuming up to one cup; the finding was not statistically significant ($p = 0.07$). This finding was similar to that of a study by Tangpricha et al. where vitamin D was not significantly associated with daily milk intake among healthy young adults ($p = 0.3$).[16]

There was no significant association between the duration of sun exposure and vitamin D in this study. This may be due to the traditional clothing habits, skin pigmentation or air pollution. Yongyot et al. reported no correlation between vitamin D and sunlight exposure in their study ($p = 0.8$).[12] Similarly, Junaid et al. categorized 264 participants into two groups, with sun exposure less than or equal to 30 minutes and greater than 30 minutes, and did not find a significant relationship between those two groups and vitamin D ($p = 0.01$).[17] In contrast, Vierucci F et al. found hypovitaminosis D eight times higher in those with low sun exposure compared to those with good sun exposure.[14]

We studied relationship of vitamin D with non-specific body pain in last six months. Participants with deficient level of vitamin D were significantly more likely to have the complain. The complain was significantly less in group with inadequate level of vitamin D and was comparable in group with adequate vitamin D. Similar result was found in a study by Knusten et al. in which patients with musculoskeletal pain, fatigue, and headache were significantly more likely to have hypovitaminosis D.[5]

What we did not understand is either the deficiency of vitamin D in almost all (98.2%) apparently healthy healthcare professionals is a real deficiency or is there a need to redefine the biological reference value for our population. There is a scope for further research on this subject.

CONCLUSION:

Hypovitaminosis D was found in almost all (98.2%) of the apparently healthy health care professionals. Factors responsible for hypovitaminosis remain obscure except for nonspecific body pain and are a subject of future research. Deficiency of vitamin D in vast majority of apparently healthy population may necessitate new biological reference value for this population and is an important area of future research.

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