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Research Article

Status of Vitamin D among Patients Visiting a Tertiary Care Centre in Rupandehi, Nepal

Tirtha Narayan Shah[1*], Amar Kumar Sinha[2], Krishna Kumar Jha[3], Ram Jiban Prasad[4]

[1]Department of Clinical Biochemistry, Karnali Academy of Health Sciences, Jumla, Nepal
[2]Department of Biochemistry, B & C Medical College, Teaching Hospital and Research Centre, Jhapa, Nepal
[3]Department of Clinical Pathology, Karnali Academy of Health Sciences, Jumla, Nepal
[4]Department of Human Anatomy and Cell Biology, Karnali Academy of Health Sciences, Jumla, Nepal

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***Corresponding author**
Tirtha Narayan Shah,
Department of Clinical Biochemistry, Karnali Academy of Health Sciences, Jumla, Nepal.
Email: tirthabiochemist15@gmail.com

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Abstract

Serum vitamin D is one of the fat-soluble vitamins which has the role in maintenance of calcium and phosphorus levels and ultimately proper bone health and various physiological processes. Although many studies prevail hypovitaminosis D, we focused to find out the pattern of elevated or decreased serum vitamin D level as its deficiency and surplus have adverse effects to our health. For this, a retrospective study was done from the records present in a hospital laboratory of Devdaha Medical College and Research Institute (DMCRI), Rupandehi, Nepal from January 2018 to December 2020 where 201 participants with 70.1% male and 29.9% female with different age groups were present. From total participants, 14.9% had deficient, 42.8% had insufficient, 35.3% had sufficient and 7% had high level of serum vitamin D. Male had 2.9% deficient and 14,9% insufficient vitamin D whereas female had 11.9% deficient, 27.8% insufficient and 7.0% surplus vitamin D. The greater prevalence of hypovitaminosis D in the females than the males could be overcome by the necessary strategies in the form of further studies and judicious supplementation vitamin D in the target population by monitoring the level of serum vitamin D.

Introduction

Vitamin D is one of the fat-soluble prohormones which has essential roles in the maintenance of various physiological processes (Sadiya *et al*., 2021). Maintenance of calcium and phosphate homeostasis is played by the essential role of vitamin D and these both minerals have important role for proper bone health (Renkema *et al*., 2008). Vitamin D helps to absorb calcium from the intestine which is utilized for mineralization of bone (Lips, 2001). Due to its insufficiency, there is the risk of osteoporotic fractures and low levels of vitamin D metabolites cause bone loss as it is associated with malabsorption of calcium (Bhattarai *et al*., 2020). Recent epidemiologic studies have found out an unpredictably high prevalence of vitamin D deficiency in apparently healthy adults living in different countries, which could be a major health problem in the future (Alfawaz *et al.*, 2014).

This 'sun-shine' vitamin synthesis begins in the skin on exposure with ultraviolet rays with further reactions takes place in the liver and the kidneys (Bhattarai *et al*., 2019). Vitamin D is derived from 7-dehyrocholesterol which then converts to cholecalciferol due to ultraviolet radiation from the sunlight in the skin. Cholecalciferol forms calcidiol (25-hydroxycholecalciferol) in the liver and calcitriol (1,25-dihydroxycholecalciferol) in the kidneys under two subsequent steps of hydroxylations (Strand *et al*., 2007; Misra *et al*., 2008). There are two types of vitamin D in humans, D_2 is derived from the food we take and D_3 derived endogenously. 25-hydroxyvitamin D (25-OH-D) derived in the liver and its active metabolite, 1-25-dihydroxyvitamin D (1-25-$(OH)_2$-D), derived in the kidney are two important metabolites of vitamin D (DeLuca, 2004). Most of these metabolites are bound to vitamin D binding protein (80–90%) and albumin (10–20%). Only a very small fraction (0.02–0.05% of 25-OH-D and 0.2–0.6% of total 1-25-$(OH)_2$-D) remains unbound. Although 1-25-$(OH)_2$-D is the biologically active form, it is widely accepted that serum 25-OH-D is the best single marker for vitamin D status (Dawson-Hughes *et al*., 2005; Holick, 2009). Although 1,25-dihydroxy vitamin D [1,25-$(OH)_2$D] is the most potent form of vitamin D, 25(OH)D is the main circulating metabolite of vitamin D and is considered the correct functional indicator of vitamin D stores in humans (Holick, 1990; Heaney, 1999).

Around one billion people is suffering from Vitamin D deficiency or insufficiency globally (Holick *et al*., 2005). Its deficiency is seen high in the developed countries and the regions of Asia, the Middle East, and India mostly in women (Bischoff-Ferrari, 2006). Role of Vitamin D deficiency has been associated as factor responsible in the pathogenesis of different cancers, heart disease, stroke, hypertension, autoimmune diseases, diabetes, depression, chronic pain, osteoarthritis, osteoporosis, myopathies, birth defect, dental diseases, etc. (Pludowski *et al*., 2013). Studies with similar objectives in this region are limited and underreported. So, this study was focused on the pattern of markedly elevated or decreased serum Vitamin D level among patients visiting DMCRI. The findings from this study will provide important information to determine what next steps will be necessary to promote optimum levels of vitamin D among the population nearby DMCRI.

Materials and Methods

This was a hospital-based retrospective study conducted in the patients visiting Devdaha Medical College and Research Institute (DMCRI), Rupandehi, Nepal. After obtaining the ethical clearance from the Institutional Review Committee (IRC) of DMCRI we obtained the data from the records maintained in the registers of hospital laboratory of DMCRI. The data obtained included: age, sex and the serum vitamin D (25-hydroxy cholecalciferol) concentrations of all the individuals who had their blood investigated for serum vitamin D in DMCRI from January 2018 to December 2020. After excluding the samples with serum vitamin D levels beyond (greater/less than) the detection limits of the instrument, and including only a single measurement for each participant during a particular single visit, a total sample consisting of 201 participants was considered for the analysis. Serum vitamin D (25-hydroxycholecalciferol) was measured in ADVIA Centaur XP (Siemens, USA) analyzer using Siemens vitamin D kits. Vitamin D deficiency was defined as 25(OH) D less than 20ng/ml, Vitamin D insufficiency as 20 -<30ng/ml, and Vitamin D sufficiency as 30-100 ng/ml, and Vitamin D toxicity as more than 100ng/ml. Vitamin D levels less than 10ng/ml were regarded as a severe deficiency (Omar *et al*., 2017). Age groups were categorized as: children (00-14 years), youth (15-24 years), adults (25-64 years) and seniors (65 years and over) (Feás, 2021). All the collected data were compiled and entered in MS-Excel and analyzed using SPSS statistical software package version 16 (SPSS 16, IBM Corp.). Descriptive statistics were used to calculate mean, median, standard deviation. The statistical significance level was set as $p < 0.05$.

Results

In our study, there were 201 participants, in which male was 29.9% and female was 70.1%. The age limit of the participants varied from 6 to 97 years (Table 1). Table 2 showed serum vitamin D according to sex and age groups. Mean value of vitamin D was more in female than male. Also, the mean vitamin D level was highest in adults and least in the children, but statistically insignificant. Results showed that among the total respondents, 14.9% had deficient, 42.8% had insufficient, 35.3% had sufficient and 7% had high level of serum vitamin D (Table 3). Comparison of the vitamin D status showed appreciable differences among the male and female participants. Among the various age groups, adults had more prevalence of hypovitaminosis D and even some children were its sufferer. Except children some of the female individuals in youth, adults and elderly had hypervitaminosis D (Table 4).

Table 1: Demographic characteristics of the participants (n=201)

Characteristics	Frequency (f)	Percentage (%)
Sex		
Male	60	29.9
Female	141	70.1
Age group (years)		
Children (0 - 14)	5	2.48
Youth (15 - 24)	27	13.43
Adults (25- 64)	119	59.20
Seniors (65 and above)	50	24.87
Median age (years)	47	

Table 2: Serum vitamin D according to sex and age group (n=201)

Variables	Mean serum vitamin D level (ng/ml)	P-value
Sex		
Male	31.86±15.70	0.096
Female	38.98±31.30	
Age group (in years)		
Children (0 - 14)	16.75±4.60	
Youth (15 - 24)	34.10±25.63	0.113
Adults (25 - 64)	39.42±29.53	
Seniors (65 and above)	34.26±24.92	
Overall	36.85± 27.73	

Table 3: Status of serum vitamin D level among the respondents (n=201)

Status of Vitamin D	Mean ± SD	Frequency (f)	Percentage (%)
Deficient	15.73 ± 3.04	30	14.9
Insufficient	23.17 ± 2.26	86	42.8
Normal	47.02 ± 20.61	71	35.3
High	114.55 ± 12.71	14	7.0

Table 4: Comparison of serum vitamin D status according to sex and age groups.

Variables	Deficient (f, %)	Insufficient (f, %)	Normal (f, %)	High (f, %)
Sex				
Male	6(2.9%)	30(14.9%)	24(11.9%)	0
Female	24(11.9%)	56(27.8%)	47(23.3%)	14(6.9%)
Age groups				
Children (00 - 14)	4(2%)	1(0.5)	0	0
Youth (15 - 24)	5(2.5%)	13(6.5%)	8(4%)	1(0.5)
Adult (25 - 64)	17(8.5%)	41(20.4%)	52(25.9%)	9(4.5%)
Elderly (65 and above)	4(2%)	31(15.4%)	11(5.5%)	4(2%)

Discussion

We conducted a study about the status of vitamin D in the patient visiting DMCRI and got male (29.9%) and female (70.1%) for the measurement of vitamin D. Of the total participants (201), children, youths, adults and elderly individuals were 2.4%, 13.4%, 59.2% and 24.8% respectively. Among them, they had 57.7% hypovitaminosis D, 35.3% normovitaminosis D and 7.0% hypervitaminosis D. Among the hypovitaminosis D, 14.9% of the total participants had deficient and 42.8% of the total participants had insufficient vitamin D status. Bhattarai *et al*. in their study found 34.8% deficient, 35.9% insufficient, 28.7% normal and 0.6% hypervitaminosis D (Bhattarai *et al*., 2019). Sadiya *et al*. had also conducted similar study in Bangladesh and found 14.1% deficient, 34.7% insufficient and 51.2% normal level of vitamin D (Sadiya *et al*., 2021). In a study conducted by Lee *et al*. in 2008 found the prevalence of vitamin D deficiency as approximately 30–50% of the general population which was close to that of our study as 57.7% (Lee *et al*., 2008). Globally, the deficiency of Vitamin D is one of the public health issue and female are the more sufferer than the male. In our study, among the low level of vitamin D category, 68.96% were female which is a serious issue and correspondence with findings conducted in Libya in 2017 by Omar *et al*. (2017). In a study conducted by Ghai *et al*. they found 73% of the female having vitamin D deficiency (Ghai *et al*., 2015). A number of factors have been postulated for the relatively lower levels of vitamin D in females including prolonged indoor stay, sunscreen use, lack of adequate sun exposure,

pregnancy and lactation (Holick, 2006). Though increased level of serum vitamin D is uncommon, we got 7.0% of the participants having hypervitaminosis D. Sharma *et al*. in their study also found 4.1% of their participants having high level of serum vitamin D level which cannot be ignored (Sharma *et al*., 2017). We found the mean age of vitamin D deficient category was 37.73 ± 20.07 years and mean age for insufficiency was 50.60 ± 22.86 years. Many reports have a similar outcome of prevalence of lower vitamin D levels with increasing ages, so it is important for early investigation and screening the status of vitamin D levels in the general population and thus helping them to prevent the unwanted outcomes due to it (Omar *et al*., 2017; Hilger *et al*., 2014). Therefore, prevention of vitamin D deficiency by adequate exposure to sunlight, food fortification and routine supplementation are recommended (Cashman and Kiely, 2011).

The limitations of this study are that the data are taken from records available in the hospital laboratory in the specified duration and do not represent the data of the entire population nearby DMCRI as the findings of this study specified only the patients who visited the hospital with some health problems and got their serum vitamin D investigated after the requisition by their clinicians. Besides age and sex there are other factors like ethnicity, seasons, certain medications, level of calcium, phosphate, parathyroid hormone, etc. have been found to be meaningfully associated with serum 25-hydroxy-cholecalciferol concentrations.

Conclusion

The status of Vitamin D in our study was found to be as follows: normal level of Vitamin D 35.3%, hypervitaminosis D 7.0% and overall hypovitaminosis D 57.7% (insufficiency: 42.8% and deficiency: 14.9%). Based on our study and findings, we recommend that further epidemiological surveys should be conducted to know the status of vitamin D level in the overall population and the important factors associated with these conditions. As we have found hypovitaminosis D to be more prevalent in our study, we recommend to provide ample consciousness regarding the importance of vitamin D in our health. Lastly, we encourage to take vitamin D supplements, diet rich in vitamin D and proper exposure to the sunlight to meet the optimum level of vitamin D to the needy individuals by monitoring the level of serum vitamin D.

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Conflict of Interest

The authors declare that there is no conflict of interest with this publication.

Authors' Contribution

Dr Tirtha Narayan Shah proposed and planned the research, collected the data and prepared the manuscript. Dr Amar Kumar Sinha approved the concept of research plan. Dr Krishna Kumar Jha and Dr Ram Jiban Prasad helped preparing the manuscript according to "authors guidelines" and finally all the authors approved the manuscript.

References

Alfawaz H, Tamim H, Alharbi S, Aljaser S and Tamimi W (2014) Vitamin D status among patients visiting a tertiary care center in Riyadh, Saudi Arabia: a retrospective review of 3475 cases. *BMC public health* **14**(1): 1-6. DOI: 10.1186/1471-2458-14-159

Bhattarai HK, Shrestha S, Rokka K and Shakya R (2020) Vitamin D, calcium, parathyroid hormone, and sex steroids in bone health and effects of aging. *Journal of osteoporosis* **2020**: 10 pages. DOI: 10.1155/2020/9324505

Bhattarai K, Manandhar N and Dhakal S (2019) Prevalence of Hypovitaminosis D in Patients Visiting a Tertiary Care Center in Chitwan, Nepal. *Journal of College of Medical Sciences-Nepal* **15**(2): 84-92. DOI: 10.3126/jcmsn.v15i2.23483

Bischoff-Ferrari HA, Giovannucci E, Willett WC, Dietrich T and Dawson-Hughes B (2006) Estimation of optimal serum concentrations of 25-hydroxyvitamin D for multiple health outcomes. *The American journal of clinical nutrition* **84**(1): 18-28. DOI: 10.1093/ajcn/84.1.18

Cashman KD and Kiely M (2011) Towards prevention of vitamin D deficiency and beyond: knowledge gaps and research needs in vitamin D nutrition and public health. *British journal of nutrition* **106**(11): 1617-1627. DOI: 10.1017/S0007114511004995

Dawson-Hughes B, Heaney RP, Holick MF, Lips P, Meunier PJ and Vieth R (2005) Estimates of optimal vitamin D status. *Osteoporos Int* **16**:713-806. DOI: 10.1007/s00198-005-1867-7

DeLuca HF (2004) Overview of general physiologic features and functions of vitamin D. *The American journal of clinical nutrition* **80**(6): 1689-1696. DOI: 10.1093/ajcn/80.6.1689S

Feás X (2021) Human Fatalities Caused by Hornet, Wasp and Bee Stings in Spain: Epidemiology at State and Sub-State Level from 1999 to 2018. *Biology* **10**(2): 73. DOI: 10.3390/biology10020073

Ghai B, Bansal D, Kapil G, Kanukula R, Lavudiya S and Sachdeva N (2015) High Prevalence of Hypovitaminosis D in Indian Chronic Low Back Patients. *Pain physician* **18**(5):853–862. DOI: 10.36076/ppj.2015/18/E853

Heaney RP (1999) Lessons for nutritional science from vitamin D. *The American Journal of Clinical Nutrition* **69**(5): 825–826. DOI: 10.1093/ajcn/69.5.825

Hilger J, Friedel A, Herr R, Rausch T, Roos F, Wahl DA, Pierroz DD, Weber P and Hoffmann K (2014) A systematic review of vitamin D status in populations worldwide. *British journal of nutrition* **111**(1): 23-45. DOI: 10.1017/S0007114513001840

Holick MF (1990) The use and interpretation of assays for vitamin D and its metabolites. *The Journal of nutrition* **120**(suppl_11): 1464-1469. DOI: 10.1093/jn/120.suppl_11.1464

Holick MF (2000) Calcium and vitamin D: diagnostics and therapeutics. *Clinics in laboratory medicine* **20**(3): 569-590. DOI: 10.1016/S0272-2712(18)30054-4

Holick MF (2006) Resurrection of vitamin D deficiency and rickets. *The Journal of clinical investigation* **116**(8): 2062-2072. DOI: 10.1172/JCI29449

Holick MF (2009) Vitamin D status: measurement, interpretation, and clinical application. *Annals of epidemiology* **19**(2): 73-78. DOI: 10.1016/j.annepidem.2007.12.001

Holick MF, Siris ES, Binkley N, Beard MK, Khan A, Katzer JT, Petruschke RA, Chen E and de Papp AE (2005) Prevalence of vitamin D inadequacy among postmenopausal North American women receiving osteoporosis therapy. *The Journal of Clinical Endocrinology & Metabolism* **90**(6): 3215-3224. DOI: 10.1210/jc.2004-2364

Lee JH, O'Keefe JH, Bell D, Hensrud DD and Holick MF (2008) Vitamin D deficiency: an important, common, and easily treatable cardiovascular risk factor? *Journal of the American College of Cardiology* **52**(24): 1949-1956. DOI: 10.1016/j.jacc.2008.08.050

Lips P (2001) Vitamin D deficiency and secondary hyperparathyroidism in the elderly: consequences for bone loss and fractures and therapeutic implications. *Endocrine reviews* **22**(4): 477-501. DOI: 10.1210/edrv.22.4.0437

Misra M, Pacaud D, Petryk A, Collett-Solberg P F and Kappy M (2008) Vitamin D deficiency in children and its management: review of current knowledge and recommendations. *Pediatrics* **122**(2): 398-417. DOI: 10.1542/peds.2007-1894

Omar M, Nouh F, Younis M, Younis M, Nabil N, Saad M and Ali M (2017) Vitamin D status and contributing factors in patients attending three polyclinics in Benghazi Libya. *Journal of Advances in Medicine and Medical Research* **24**(5): 1-13. DOI: 10.9734/JAMMR/2017/37483

Pludowski P, Holick MF, Pilz S, Wagner CL, Hollis BW, Grant WB, Shoenfeld Y, Lerchbaum E, Llewellyn DJ, Kienreich K and Soni M (2013) Vitamin D effects on musculoskeletal health, immunity, autoimmunity, cardiovascular disease, cancer, fertility, pregnancy, dementia and mortality—a review of recent evidence. *Autoimmunity reviews* **12**(10): 976-989. DOI: 10.1016/j.autrev.2013.02.004

Renkema KY, Alexander RT, Bindels RJ and Hoenderop JG (2008) Calcium and phosphate homeostasis: concerted interplay of new regulators. *Annals of medicine* **40**(2): 82-91. DOI: 10.1080/07853890701689645

Sadiya S, Rana M, Parvez M, Monowara M and Sheuly AH (2021) Profile of Vitamin D in Patients Attending at Tertiary Care Hospital, Bangladesh. *American Journal of Internal Medicine* **9**(2): 83-86. DOI: 10.11648/j.ajim.20210902.14

Sharma LK, Dutta D, Sharma N and Gadpayle AK (2017) The increasing problem of subclinical and overt hypervitaminosis D in India: An institutional experience and review. *Nutrition* **34**: 76-81. DOI: 10.1016/j.nut.2016.09.014

Strand, MA, Perry J, Jin M, Tracer DP, Fischer PR, Zhang P, Xi W and Li S (2007) Diagnosis of rickets and reassessment of prevalence among rural children in northern China. *Pediatrics International* **49**(2): 202-209. DOI: 10.1111/j.1442-200X.2007.02343.x