Vitamin D Deficiency and Associated Parameters among Cardiovascular Patients in a Tertiary Care Institution of Southern Rajasthan

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Abstract:

Introduction: Cardiovascular diseases are major public health problem and leading cause of mortality. A check on each modifiable risk factor will be advantageous. Micronutrient such as vitamin D deficiency can be one such factor, since it is well known that vitamin D affects all systems of the body including cardiovascular. **Objective:** 1. To estimate vitamin D deficiency among patients with cardiovascular illnesses. 2. To determine the association between vitamin D deficiency and socio-demographic parameters, as well as selected laboratory parameters like lipid profile, random blood sugar, complete blood count in heart patients. **Method:** A cross sectional study was conducted over a period of one year, among 250 patients admitted at cardiology ward of MB Government Hospital, Udaipur whose socio-demographic profile, laboratory investigations like vitamin D, lipid profile, random blood sugar, CBC were observed and reports were entered in codebook. Data was analyzed using MS Excel, Open Epi v 3.01. **Results:** In the study 174 males and 76 females were included. Vitamin D deficiency was found in 92% of cardiovascular patients. Vitamin D deficiency was significantly associated with female gender (p value=0.01), urban residency(p value= 0.0005), socio-economic status (p value= 0.004) and semi-vegetarian diet (p value < 0.01).Most common symptom was tiredness (34%); most common coexisting non-communicable disease was hypertension (74.8%) and most common past infection was COVID-19 (9.2%). Participants with vitamin D deficiency had increased BMI, increased random blood sugar, decreased haemoglobin and more incline towards dyslipidemia. **Conclusion:** Vitamin D deficiency was present in significantly large proportion of cardiovascular patients. Females, urban residents and individuals with vegetarian diet and increased BMI are at more risk. Frequent evaluations including lipid profile, blood sugar, CBC should be encouraged.

Keywords : Cardiovascular disease, Deficiency, Vitamin D

Introduction:

One of the major public health problems and the leading cause of mortality all over the globe are cardiovascular diseases (CVD). Many people die annually from cardiovascular diseases than from any other cause. As per World Health Organization (WHO), 44% of deaths from non-communicable diseases are due to cardiovascular diseases.[1,2] There are various risk factors linked to development of cardiovascular disease which can be broadly divided into modifiable (lifestyle, dietary) and non-modifiable (age, sex, familial). A check on each modifiable risk factor will be advantageous. Micronutrient deficiency can be one such factor. Vitamin D is one of such micronutrients which affect all the systems of the body including cardiovascular system.

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Vitamin D deficiency leading to vascular disease is a complex mechanism. It involves raised parathyroid hormone levels leading to heightened renin–angiotensin–aldosterone system (RAAS) activity, insulin resistance and inflammation, thereby leading to atherosclerosis and cardiovascular disease. Vitamin D acts through Vitamin D Receptor (VDR) which is present in almost all the tissues of human body, including cardiovascular tissues. Cardiovascular effects of Vitamin D share the common initial steps of nuclear and plasma membrane VDR activation at the cellular level.[3]

Thus considering the fact that vitamin D affects all systems of body including cardiovascular, this study was conducted with an objective to estimate vitamin D deficiency and to determine the association between vitamin D deficiency and socio demographic profile along with various laboratory parameters like lipid profile, random blood sugar, complete blood count.

Method:

A cross sectional study from February 2021 to December 2021 was conducted among 250 patients admitted at cardiology ward of MB Government Hospital (MBGH) attached to RNT Medical College, Udaipur.

Study Population:

Study was conducted among patients admitted at cardiology ward of MBGH, Udaipur who fulfilled inclusion criteria, after obtaining written consent from them. Sample size was calculated on the basis of a previous study by Oberoi D et al[3], through the formula $n= (Z_{1-\alpha/2})^2 \times p \times q / L^2$, where $Z_{1-\alpha/2}$ is a constant of value 1.96, 'p' is prevalence, 'q' is 100-p, 'L' is allowable error The sample size for the study was calculated to be 235. Considering the drop-outs, the sample size was finalized to be 250.Non-probability consecutive sampling technique was used.

Inclusion Criteria:

- Patients admitted in the cardiology ward of MB Government Hospital, Udaipur who agreed to participate and gave written consent.

Exclusion Criteria:

- Participants with acute critical illness, chronic renal or hepatic disease, thyroid or parathyroid disease.
- Participants who were on vitamin D supplements currently or in the past 3 months.
- Participants on drugs that affect metabolism or absorption of vitamin D (e.g. oral contraceptive pills, some antibiotics such as gentamicin, neomycin; anti-seizure medications like phenobarbital, phenytoin).

Study Procedure:

A semi-structured questionnaire was used for socio-demographic details like age, gender, level of education, socio-economic class (according to Modified B. G. Prasad classification, year 2021)[4] and type of residence. Other details like body mass index, frequency of tobacco or alcohol consumption and dietary patterns were also recorded.

Participants were classified into three groups according to frequency of tobacco consumption[5] :

i. Frequent or regular consumers - Those who consume daily

ii. Occasional consumers- Those who consume less than daily

iii. Never consumers- Those who do not consume at all.

Participants were classified into three groups according to frequency of alcohol consumption[6] :

I. Frequent consumers - Those who consume more than 10 drinks in a week and hardly have any day free of alcohol.

ii. Occasional consumers - Those who consume less than 10 drinks in a week and have 2 or more alcohol free days in a week.

iii. Never consumers- those who have never had alcohol.

According to dietary pattern, participants were classified as follows [7] :

i. Vegetarian- A person who does not eat meat, fish or egg, especially for religious or health reasons.

ii. Non vegetarian- A person who is not a vegetarian i.e. someone who consumes meat or fish as a major source of protein. Person who consumes meat more than thrice a week is included in non- vegetarian diet.

iii. Semi-vegetarian diet - Consumption of vegetarian food on most of the days of a week; occasional or less than thrice consumption of meat in a week or consumption of eggs but not meat.

Blood samples were collected for laboratory investigations like serum vitamin D, lipid profile, Random Blood Sugar (RBS) and Complete Blood Count (CBC). Serum Vitamin D level of 20-32 ng/ml was considered to be normal range and participants with levels less than 20 ng/ml were considered to be vitamin D deficient.[8] Details were entered in codebook.

Data Analysis:

To enter data, a codebook was prepared. Data was compiled and analyzed using MS Excel 2007 and OpenEpi v 3.01. Independent t-test and chi square tests were applied for statistical analysis of data. P-value< 0.05 was considered statistically significant.

Results:

The mean serum Vitamin D of all the 250 participants was 12.6 ±6.3 ng/ml. Vitamin D deficiency was found in 230 (92%) participants, the mean level of serum vitamin D in them was 11.3 ± 3.4 ng/ml. While the rest 20 (8%) participants had serum vitamin D in normal range with mean level of 27.3± 11.6 ng/ml.

Table 1 depicts socio-demographic profile of study participants. Statistically significant association was observed between vitamin D deficiency and gender, socio-economic (S.E.) class and type of residence; with deficiency being more commonly present in female gender, socio-economic class IV and participants residing in urban areas.

Vitamin D deficiency was found to be increasing with increase in Body Mass Index [BMI]. The association between vitamin D deficiency and BMI was statistically insignificant (p value=0.61). Vitamin D deficiency was most commonly seen in frequent consumers for both tobacco and alcohol, although the association in both the groups was statistically insignificant (p value=0.22 and 0.45 respectively). There was a statistically significant association between vitamin D deficiency and dietary patterns (p value < 0.01).Deficiency was maximum in semi-vegetarian participants while least in non-vegetarians. (Table 2)

Among all the participants who had vitamin D deficiency, 44.7% were symptomatic and 55.2% were asymptomatic. The most common symptom experienced by participants was tiredness (34%) followed by impaired wound healing (10%).

Participants were enquired about co-existing non-communicable diseases (NCDs). The most common NCD reported was hypertension which was present in 74.8% , followed by diabetes mellitus in 37.6% participants. Deficiency of Vitamin D was significantly associated with co-existing conditions like Hypertension and COPD with p value 0.03 and 0.002, respectively). (Table 3)

Participants with vitamin D deficiency showed a high incline towards acquiring infections. All the participants who had suffered from COVID-19 (9.2%) and tuberculosis (0.8%) were vitamin D deficient. Among the participants who had suffered from typhoid, 90% were vitamin D deficient. Most common past infection was COVID-19. Among the parameters of lipid profile, the difference in mean serum HDL level was found to be significant between both the groups, that is vitamin D deficient and sufficient (p-value 0.0002). (Table 4)

Table 1 : Association between Vitamin D deficiency and Socio-demographic profile among study participants (N=250)

Variables	n (%)	Participants		Chi-square value	p value
		Vitamin (N=230) D deficient	Vitamin (N=20) D sufficient		
Age (years)					
< 40	5 (2%)	4 (80%)	1 (20%)	5.97	0.20
40-49	38 (15.2%)	33 (86.8%)	5 (13.1%)		
50-59	81 (32.4%)	76 (93.8%)	5 (6.1%)		
60-69	75 (30%)	67 (89.3%)	8 (10.6%)		
≥70	51 (20.4%)	50 (98.03%)	1 (1.9%)		
Gender					
Female	76 (30.4%)	75 (98.6%)	1(1.3%)	6.62	0.01
Male	174 (69.6%)	155 (89.08%)	19 (10.9%)		
Level of Education					
Illiterate	8 (3.2)	7 (87.5)	1 (12.5)	2.29	0.68
Primary	66 (26.4)	60 (90.9)	6 (9.09)		
Secondary	89 (35.6)	81 (91.01)	8 (8.9)		
Higher secondary	58 (23.2)	56 (96.5)	2 (3.4)		
Graduate and above	29 (11.6)	26 (89.6)	3 (10.3)		
Socio-economic Class#					
I	51 (20.4)	43 (84.3)	8 (15.6)	15.2	0.004
II	112 (44.8)	108 (96.4)	4 (3.5)		
III	30 (12)	27(90)	3 (10)		
IV	41 (16.4)	40 (97.5)	1 (2.4)		
V	16 (6.4)	12 (75)	4 (25)		
Type of Residence					
Rural	85 (34%)	70 (82.3%)	15 (17.6%)	16.2	0.0005
Urban	165 (66%)	160 (96.9%)	5 (3.03%)		

As per Modified B. G. Prasad Classification

Participants with vitamin D deficiency had increased mean random blood sugar (143.35±50.95 mg/dl). While participants with vitamin D sufficiency had normal value of mean random blood sugar (130.45±48.84 mg/dl). This difference was found to be statistically insignificant (p value=0.277).

Among the parameters of Complete Blood Count (CBC) profile, the difference in haemoglobin level was found to be significant in both the groups, that is vitamin D deficient and sufficient (p-value 0.006). No significant difference was observed in values of Total Leucocyte Count, Red Blood Cell count, platelet, Mean Corpuscular Hemoglobin Concentration and Mean Lymphocyte Volume among participants who had vitamin D deficiency and those who do not have deficiency.

Table 2: Association of Vitamin D deficiency with BMI, Addiction and Diet among study participants (N=250)

Variables	n (%)	Participants		Chi-square value	p value
		Vitamin D deficient (N=230)	Vitamin D sufficient (N=20)		
BMI (kg/m^2)					
<18.50	11(4.4)	9 (81.8)	2 (18.1)	2.66	0.61
18.5-24.99	130 (52)	119 (91.5)	11 (8.4)		
25.0-29.99	88 (35.2)	83 (94.3)	5 (5.6)		
30-34.99	19 (7.6)	18 (94.7)	1 (5.2)		
35.0-39.99	2 (0.8)	2 (100)	0 (0)		
Frequency of tobacco consumption					
Frequent	75 (30)	72 (96)	3 (4)	2.98	0.22
Occasional	88 (35.2)	78 (88.6)	10 (11.3)		
Never	87 (34.8)	80 (91.9)	7 (8.04)		
Frequency of alcohol consumption					
Frequent	36 (14.4)	34 (94.4)	2 (5.5)	1.5	0.45
Occasional	121 (48.4)	113 (93.3)	8 (6.6)		
Never	93 (37.2)	83 (89.2)	10 (10.7)		
Dietary Pattern					
Vegetarian	145 (58%)	134 (92.4%)	11 (7.5%)	25.8	<0.01
Non vegetarian	14 (5.6%)	8 (57.1%)	6 (42.8%)		
Semivegetarian	91(36.4%)	88 (96.7%)	3 (3.2%)		

Table 3: Association of Coexisting NCDs with Vitamin D deficiency (N=250)

Coexisting Non-Communicable Disease *	Participants		n(%)	Chi-Square value	p value
	Vitamin D deficiency	Vitamin D sufficiency			
Hypertension	176 (94.1%)	11 (5.8%)	187 (100%)	4.52	0.03
Diabetes Mellitus	85 (90.4%)	9 (9.5%)	94 (100%)	0.50	0.47
Osteoarthritis	9 (81.8%)	2 (18.1%)	11 (100%)	1.62	0.20
COPD	1 (33.3%)	2 (66.6%)	3 (100%)	14.2	0.002

*Mutually inclusive

Table 4: Association of Vitamin D deficiency with Lipid profile among study participants (N=250)

Lipid profile (mg/dl)	Total	Participants		t value	p value
		Vitamin D deficient (N=230)	Vitamin D sufficient (N=20)		
Mean Serum Total cholesterol	221.03±64.3	221.6±64.8	214.3±59.3	0.48	0.62
Mean Serum TG	235.5±96.8	237.6±97.1	212.3±92.4	1.12	0.26
Mean Serum HDL	46.8±9.8	46.2±8.9	53.9±16.1	-3.42	0.0007
Mean Serum LDL	158.1±50.9	157.5±50.6	164.4±54.8	-0.58	0.56
Mean Serum VLDL	36.9±17.5	36.9±17.5	36.1±17.7	0.19	0.84

Discussion:

The rising prevalence of cardiovascular diseases has made it utmost important to address and control each and every modifiable risk factor to halt the progress.

In the current study, Vitamin D deficiency was found among 92% cardiovascular patients. Similar to this Lee et al[9] reported 96% patients of acute coronary syndromes to be vitamin D deficient. While Oberoi et al[3] and Raina et al[10] reported 64% and 75% prevalence respectively.

Vitamin D deficiency was seen to increase with increasing age, although there was a dip at age group 60-69 years. Similarly, Raina et al[10], Aleksova et al[11], Lavie et al[12] in their respective studies observed that the increasing age of the cases was inversely related to vitamin D levels. Roffe-Vazquez DN et al[13], in contrast to our study found vitamin D deficiency more among people of younger age.

In this study no definitive pattern was seen in vitamin D deficiency with socio economic class; which was in contrast to the studies done by Oberoi et al[3] and Divakar U et al[14] in which vitamin D level was inversely related to financial status of subjects.

Deficiency of vitamin D was observed to be maximum in frequent consumers of tobacco (96%).Similarly Oberoi et al[3] and Polytarchou K et al [15] found inverse relation of vitamin D level and tobacco consumption.

In the current study it was observed that deficiency of vitamin D increased with increase in BMI. This was in accordance with other studies like Aleksova et al [11], Divakar U et al[14] and Kumaratne et al[16] where direct relation between vitamin D deficiency and increase in BMI was seen. However Roffe-Vazquez DN et al [13], in their study found no association of vitamin D levels and BMI.

Similarly, vitamin D deficiency was found to be significantly associated with presence of diabetes in a study conducted by Vacek et al.[17] Also in a study conducted by Anderson JL et al[18], on analysing 27000 patients of vitamin D deficiency, 60% were found to be associated with highly significant increase in prevalence of diabetes mellitus and hypertension. In the present study, it was seen that the past history of infective disease was significantly higher in participants with vitamin deficiency. The most common infection reported was COVID-19 (9.2%). A study conducted by Padhi et al[19] also showed an inverse correlation between the mean level of vitamin D and SARS-CoV-2 infection rate and mortality rate.Similar results were also seen in a hospital based study conducted by Singh et al.[20] Apart from COVID-19, past history of typhoid, tuberculosis and hepatitis was also found in study participants.

The mean serum triglyceride of study participants was raised. The serum level was also higher in participants who were deficient as compared to those who had sufficient vitamin levels. Same findings were reported in studies done by Roffe-Vazquez DN et al [13] and Glueck et al.[21]

Thus, the participants of the current study who had vitamin deficiency had more dyslipidemia as compared to those with vitamin sufficiency, which is in agreement to a number of studies like Polytarchou K et al[15], Kumaratne et al[16] and Anderson JL et al [18] where association between vitamin D deficiency and dyslipidemia was established.

The mean serum RBS was above the normal range in participants in the deficient group of vitamin D and in the normal range among the sufficient group participants of both the vitamins. Similar association between blood glucose and vitamin D deficiency was observed in studies done by Aljefree et al[22] and Divakar U et al.[14] In contrast to this study, Kumaratne et al[16] found no difference in blood sugars of patients who had vitamin D deficiency as compared to those with vitamin D sufficiency.

Soliman et al[23] conducted an interventional study and concluded no significant effect on vitamin D therapy on TLC; which was in agreement with

findings of the current study. In contrast to the present study, Polytarchou K et al[15] observed TLC to be increased in the patients. Similarly, Soliman et al[23] observed no significant effect of VDD on RBC count when status was compared before and after intervention.

Conclusion:

Vitamin D deficiency was seen in large proportion of cardiovascular patients. It was found to be associated with a number of sociodemographic factors like female gender, urban residency, semi-vegetarian diet. Vitamin D deficient participants had increased Body Mass Index, increased random blood sugar, decreased hemoglobin and more incline toward dyslipidemia. The most common past infection seen was COVID-19 and the most common non-communicable disease reported was hypertension.

Recommendations:

Increased counselling on vitamin D intake and routine screening should be given importance especially in females, urban residents, those who consume more vegetarian food and people with increased BMI. Apart from these, investigations like lipid profile, blood sugar and complete blood count should also be conducted frequently. Increased exposure to sunlight, fortified food and supplements can be emphasized upon.

Limitations:

This study was done among patients of cardiovascular diseases and no comparison was made with people who had no such diseases. The patients were counselled but no interventional support in the form of vitamin supplementation was provided.

Declaration:

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Conflict of Interest: Nil

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