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Original Research Article

Study of lipid profile in subjects with vitamin D3 deficiency

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Abstract

Introduction: Vitamin D3 deficiency is more prevalent throughout India. Some recent studies have suggested possible associations between lipid profile and deficiency of vitamin D3.
Aim and Objectives: To investigate the association between vitamin D3 and lipid profile in Indian subjects.
Study design: This is a cross-sectional study.
Material and Method: Two hundred individuals were considered for the study, from whom 100 individuals with vitamin D3 deficiency were included in the case group and control groups contain 100 normal healthy individuals. Serum concentration of vitamin D_3 and lipid profile were measured by fully automated biochemistry analyzers.
Results: The mean serum concentrations of total cholesterol, LDL, triglyceride, VLDL, TC/HDL ratio, LDL/HDL ratio in the case group (190.92 ± 27.64 mg/dl, 117.01 ± 24.99 mg/dl, 116.35 ± 29.76 mg/dl, 25.71 ± 10.54 mg/dl, 4.21 ± 1.21, 2.62 ± 0.96 respectively) were statistically significantly higher than the control group (172.91 ± 21.40 mg/dl, 97.38 ± 17.96 mg/dl, 102.75 ± 29.89 mg/dl, 20.55 ± 5.98 mg/dl, 3.20 ± 0.50, 1.81 ± 0.42 respectively) with P value of <0.01 and the mean serum HDL concentration in the case group (48.18 ± 12.52 mg/dl) was statistically significantly lower than the control group (54.95 ± 8.73 mg/dl) with P value of <0.0001.
Conclusion: Serum vitamin D3 concentrations showed an inverse correlation with s. cholesterol, LDL, VLDL, triglyceride (atherogenic lipids) and a positive correlation with HDL (atheroprotective).
Keywords: Vitamin D_3, Dyslipidaemia, lipid profile, cholesterol, LDL, HDL.

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1. Introduction

The deficiency of vitamin D3 is prevalent worldwide and the vitamin D3 deficiency is associated with an atherogenic lipid profile. [1] In humans, most of the vitamin D is synthesized cutaneously through sun-light exposure (by ultraviolet B radiation) while the remaining vitamin D is obtained from the diet. [2-4] The total vitamin D (cutaneously synthesized and ingested in diet) is immediately hydroxylated by liver to form 25-hydroxyvitamin D(25[OH]D) which is the predominant form of the circulating vitamin D. A high prevalence of vitamin D deficiency has been reported among all age groups in the sun rich Asian countries such as India. The major causes for high prevalence of vitamin D deficiency are skin complexion, sunlight exposure, use of sunscreens and lack of vitamin D in diet. [5]

Vitamin D has an important role in calcium homeostasis and skeletal health. In addition, the role of the vitamin D has now been implicated with various health and disease processes such as cardiovascular disease (CVD), hypertension, congestive heart failure, type 2 diabetes, and obesity. [4-6] Previous study has shown that the level of vitamin D3 is inversely associated with glycemic control in the diabetic patients. [7]

Some epidemiological studies have shown the association of circulating vitamin D concentrations with adverse lipid profile which could mediate increased risk of CVD. [4,5,8] Observational studies have demonstrated that the high levels of vitamin D are associated with a favorable lipid profile, whereas the low levels of vitamin D are associated with an atherogenic lipid profile. [9] The

mechanism of interrelationship between vitamin D and lipid profile is not clear.

Vitamin D3 deficiency prevails in epidemic proportions all over the Indian subcontinent, with a prevalence of 70%–100% of the general population. [10] Vitamin D deficiency and its relationship with serum lipids appear to vary by ethnicity and gender. [8] Some of the factors such as obesity and lifestyle factors can influence both vitamin D concentrations and the lipid profile. Thus, to study the association between vitamin D concentrations and lipid profile, we undertook this study in a population of apparently healthy Indian population.

2. Material and Method

In this cross-sectional study, subjects were enrolled from health check-up clinic of the Shree Krishna Hospital, Karamsad. Two hundred individuals were considered for the study, from which 100 individuals were selected each in the case and control groups after applying the inclusion and exclusion criteria. The approval of Institutional Ethics Committee was taken before the study. Written informed consents were obtained from all the participants, and then complete history was taken including physical examinations.

2.1 Inclusion criteria

The case group included 100 subjects with vitamin D deficiency.

The control group included 100 age and sex matched healthy males and females.

2.2 Exclusion criteria

Individuals were having liver diseases, kidney diseases, any major illness and individuals on vitamin D_3supplements [diagnosed by Liver Function Test (LFT), Renal Function Test (RFT), past and drug history) were excluded from the study.

A fasting sample of venous blood was drawn in plain vacutainer with strict aseptic precaution after 8 - 12 hours of fasting. Serum was separated after centrifugation at 3000 rpm for 10 – 20minutes, and all the tests were done in Biochemistry Laboratory by fully automated instruments. Serum total cholesterol was analyzed by colorimetric assay with CHOD-POD, serum triglyceride was analyzed by colorimetric endpoint GPO-PAP, serum HDL was analyzed by homogenous enzymatic method in Cobas Integra 400 Plus clinical chemistry analyzer, while vitamin D_3 was measured by the competitive principle of electrochemiluminescence (ECL) method in Cobas e-411 immunoassay analyzer. Serum LDL & VLDL were calculated by using Friedewald's formula.

2.3 Statistical Analysis

Statistical analysis was carried out by using the commercially available statistical software MedCalc version 14.8.1 and Microsoft Office 2016 was used for calculations of means and SDs. Student's t-test (unpaired) was used for comparison between the case and the control groups, and the P value of less than 0.05 was considered statistically significant. Box and Whisker Plot was used for the comparison of the vitamin D_3 levels in the cases and the controls. Pearson's Correlation Coefficient was used for correlation analysis.

3. Result

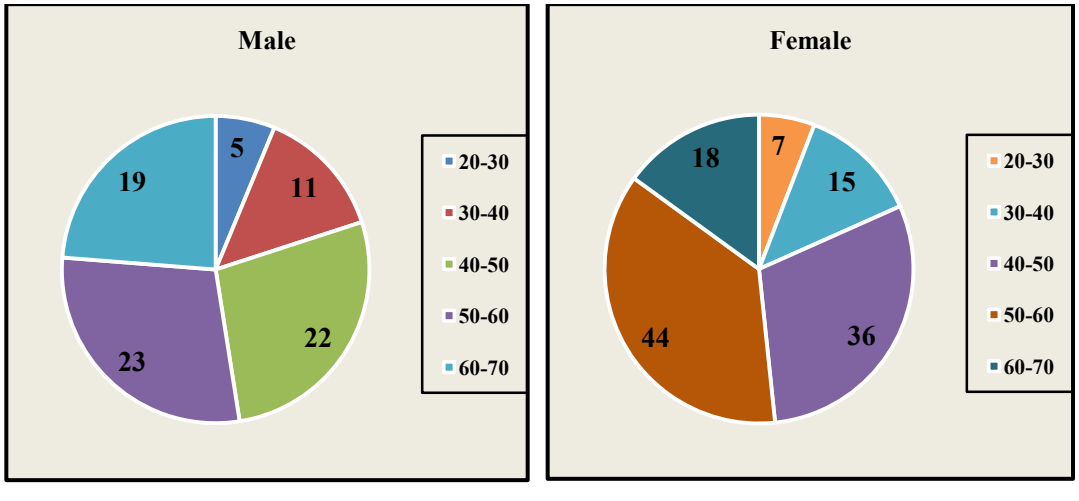
3.1 Demographic data of the study groups

In the study 80 men and 120 women were included, out of which 100 participants with vitamin D deficiency were included in the case group, and another 100 healthy individuals were included in the control group. Details of demographic data of the study were shown in Table 1 and Figure 1a & 1b.

Table 1: Age and Gender Distribution of the case and the control groups

Age (Years)	Case Group			Control Group		
	Total	Male	Female	Total	Male	Female
20-30	6	3	3	6	2	4
30-40	13	5	8	13	6	7
40-50	28	11	17	30	11	19
50-60	34	10	24	33	13	20
60-70	19	11	8	18	8	10
	100	40	60	100	40	60

Figure 1a & 1b: Gender Distributions of the study groups



3.2 Comparison by Student's t-test

The mean age of the participants in the case group and the control group are 50.39 ± 11.53 years and 49.83 ± 10.85 years respectively, which are statistically similar with a P value of 0.72. Table 2 shows details of various characteristics of the case and the control groups.

Table 2: Comparison of various parameters in the case and the control groups (The independent t-tests)

Parameters	Case (Mean ± SD)	Control (Mean ± SD)	P value*
Age (Years)	50.39 ± 11.53	49.83 ± 10.85	0.72
S. Cholesterol (mg/dl)	190.92 ± 27.64	172.91 ± 21.40	<0.0001
HDL (mg/dl)	48.18 ± 12.52	54.95 ± 8.73	<0.0001
LDL (mg/dl)	117.01 ± 24.99	97.38 ± 17.96	<0.0001
S. Triglyceride (mg/dl)	116.35 ± 29.76	102.75 ± 29.89	<0.01
V L D L (mg/dl)	25.71 ± 10.54	20.55 ± 5.98	< 0.0001
TC/HDL ratio	4.21 ± 1.21	3.20 ± 0.50	< 0.0001
LDL/HDL ratio	2.62 ± 0.96	1.81 ± 0.42	< 0.0001
Vitamin D3 (nmol/L)	18.60 ± 4.3	56.52 ± 11.22	< 0.0001

*P < 0.05 = Statistically Significant

The mean serum concentrations of total cholesterol, LDL, triglyceride, VLDL, TC/HDL ratio, LDL/HDL ratio in the case group (190.92 ± 27.64 mg/dl, 117.01 ± 24.99 mg/dl, 116.35 ± 29.76 mg/dl, 25.71 ± 10.54 mg/dl, 4.21 ± 1.21, 2.62 ± 0.96 respectively) were statistically significantly higher than the control group (172.91 ± 21.40 mg/dl, 97.38 ± 17.96 mg/dl, 102.75 ± 29.89 mg/dl, 20.55 ± 5.98 mg/dl, 3.20 ± 0.50, 1.81 ± 0.42 respectively) with P value of <0.01 and the mean serum HDL concentration in the case group (48.18 ± 12.52 mg/dl) was statistically significant lower than the control group (54.95 ± 8.73 mg/dl) with P value of <0.0001.

Figure 2 shows that the level of vitamin D_3 is significantly low in the case group than healthy individuals of the control group.

Figure 2: Showing Vitamin D_3 (nmol/L) level in the case and the control groups with Box and Whisker Plot

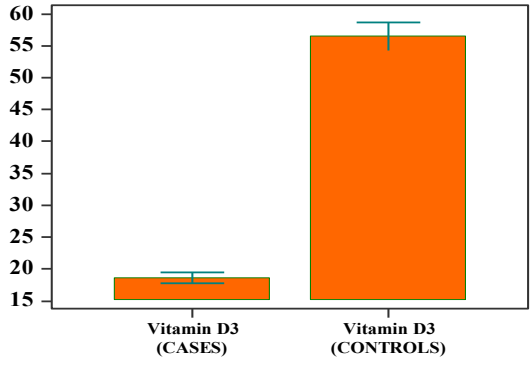


Table 3: Correlation of serum vitamin D3 with serum lipids in the study population

Parameters	Correlation coefficient r
S. Cholesterol	-0.32
Triglyceride	-0.20
H D L	0.30
L D L	-0.40
V L D L	-0.26
TC/HDL ratio	-0.47
LDL/HDL ratio	-0.47

Table 3 illustrates the correlation between serum vitamin D3 and serum lipid concentrations. Serum vitamin D3 concentrations showed significant inverse correlation with S. cholesterol (r= -0.32), triglyceride (r= -0.20), LDL (r= -0.40), VLDL (r= -0.26) and showed a positive correlation with HDL (r= 0.30). Serum vitamin D3 concentrations also showed significant inverse correlation with the lipid ratios, i.e., TC/HDL-C (r =−0.47) and LDL/HDL (r = −0.47).

4. Discussion

Our study showed that the subjects with vitamin D3 deficiency have significantly higher concentrations of atherogenic lipid profile (S. cholesterol, LDL, triglyceride, VLDL), while significantly lower concentration of athero-protective lipid (HDL) as compared to the control group subjects with adequate vitamin D3 levels. Our study results also showed positive correlation of serum vitamin D3 and serum HDL, while inverse correlation of serum vitamin D3 with serum cholesterol, triglyceride, LDL and VLDL. In addition, lipid ratios, i.e., TC/HDL and LDL/HDL also showed inverse correlation with serum vitamin D3.

Our results are in line with some of the recent association studies done on the Indian population, where Vitamin D concentration was inversely correlated with atherogenic lipids (TC, TG, and LDL) and showed strong positive correlation with athero-protective lipids (HDL). [1, 11-15]

Some studies done on population other than Indian also showed same results like, Gaddipati *et al* study done on Americans suggested that serum vitamin D levels were negatively correlated with total cholesterol, triglycerides and LDL and positively correlated with HDL.[16] Jungert A *et al* found that vitamin D3 levels were positively associated with HDL and inversely associated with TC, HDL, LDL: HDL ratio and TC: HDL ratio among the elderly women in Germany which is in accordance to the present study. [17] Karhapaa *et al*., found that deficiency of vitamin D3 was associated with high total cholesterol in

Belgian men [18]. Auwerx *et al*. observed increased total cholesterol levels associated with deficiency of vitamin D3 in Finnish people [19].Martins *et al*. studied non-Hispanic black and Mexican American individuals of the age of 60 and older and noted elevated total cholesterol levels with vitamin D3 deficiency [20]. Similar findings were also detected in Korean adults [21] and Chinese population. [22] Jorde *et al*. reported negative correlation of the lipid ratios TC/HDL, and LDL/HDL with serum vitamin D3. [23]

Vitamin D mediated reduction in serum triglycerides by two mechanisms, first vitamin D enhance intestinal serum calcium absorption which reduces serum triglycerides by reducing hepatic triglyceride formation and secretion [21] and second mechanism mediated by suppressive effect on serum parathyroid hormone (PTH) concentration which reduce serum triglycerides via increased peripheral removal. [24]

It seems that vitamin D deficiency may be associated with the increased risk of dyslipidaemias but the data to conclude this is not clear. As a cross-sectional design, the present study has several limitations. Also, there is no cause and effect relationship between vitamin D3 and lipid profile. More studies are needed with vitamin D3 supplementation and long-term observation of the changes in lipid profile.

5. Conclusion

Serum vitamin D3 concentrations showed an inverse correlation with s. cholesterol, LDL, VLDL, triglyceride (atherogenic lipids) and a positive correlation with serum HDL (atheroprotective). The study suggests that vitamin D3 deficiency can lead to dyslipidaemia and increases the risk of cardiovascular diseases. Further randomized controlled trials are required to confirm causation.

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