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Panacea Journal of Medical Sciences

Journal homepage: http://www.pjms.in/

Original Research Article

Study of biochemical parameters along with correlation of Lipid profile and Vitamin D in obese and non-obese subjects

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ARTICLE INFO

Article history:
Received 01-08-2022
Accepted 16-11-2022
Available online 13-08-2024

Keywords:
Vitamin D deficiency
Obesity
Lipid profiles
Bone mineral density

ABSTRACT

Background: Vitamin D deficiency can impose significant development of cardiovascular diseases along with the cardiovascular risk factors such as obesity, diabetes, hypertension and dyslipidemia. In this backdrop, the present study was carried to evaluate the association between 25(OH) vitamin D levels and lipid profiles in subjects with vitamin D insufficiency and those with normal lipid profiles.
Methods: This study was carried out among the obese and non-obese individuals with vitamin D deficiency. Vitamin D level was estimated in all the patients. Further, the lipid profiles, Homeostatic Model Assessment HOMA and bone density (T and Z scores) were measured in all the patients.
Results: The obese subjects displayed significant increase in the BMI, VSF and TBF in as compared to the non-obese subjects. Further, the T and Z scores, Insulin, HOMA-IR, AST and ALT levels was increased in obese subjects when compared to non-obese subjects and found to be significant. In addition, there was significant negative correlation between VLDL and triglycerides in vitamin D deficiency subjects.
Conclusion: Thus the present study, confirm that there was marked alteration in lipid profiles in subjects with vitamin D deficiency.

1. Introduction

Vitamin 25(OH) D deficiency is a clinical condition when the level is lower than 50 nmol/L (20 ng/mL).[1,2] Globally, vitamin D deficiency is a common condition and impose major public health problem.[3] Mounting evidences show that apart from vitamin D functions on bone health, it alters immune function, renin–angiotensin system and decreases insulin resistance in pregnant women.[4] The vitamin D receptor is localized in wide range of cells cardiomyocytes, endothelial and immune cells.[5] Mounting studies shows that vitamin D insufficiency may impose risk of hypertension, left ventricular hypertrophy, cardiac failure, diabetes and metabolic syndrome.[6,7] Raised levels of lipid profiles such as cholesterol, triglyceride, and low density lipoprotein (LDL), as reduced level of high density lipoprotein (HDL) contribute to the risk of developing atherosclerosis and CVD.[8] Lowering serum cholesterol has been shown to reduce cardiovascular morbidity and mortality. Vitamin D ability to affect CVD via changing lipid profiles has yet to be extensively studied. According to prior studies, there appears to be a connection between 25 (OH) D levels and serum lipids. The results, on the other hand, are mixed. Mounting studies displayed the significant relationship between serum vitamin D levels and lipid profiles.[9,10] In addition, compared to LDL-C,[11] small and dense LDL (sdLDL) is observed to lodge more easily on the artery wall. Despite the significant high level of vitamin D insufficiency for India's healthy population, no research has looked at its relationship with lipid profile. By studying the association between serum levels of 25(OH) D and lipid profile among

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https://doi.org/10.18231/j.pjms.2024.064

the Indian subjects, this study will address a knowledge vacuum. The goal of this research was to see if there was a link between 25(OH) vitamin D levels and lipid profiles in individuals with vitamin D insufficiency and those with normal lipid profiles.

2. Materials and Methods

Healthy adults, obese (n=63) and non-obese (n=20), aged more than 18 years, were recruited from the outpatient department of biochemistry government medical college and hospital Aurangabad between July 2016 to July 2018.

2.1. Inclusion criteria

Obese subjects had a BMI ≥95th percentile for their age and gender, while non-obese subjects had a BMI in the range of 5th to 85th percentile for their age and gender.

2.2. Exclusion criteria

Patients having previous history of cancer, heart disease, diabetes, renal or hepatic disorders were excluded from the study.

Patients suffering from the disease which affects the serum vitamin D levels such as thyroid disorders were excluded from the study.

Blood pressure, height, and weight were all measured using standard methods. Fasting insulin, lipid panel (total cholesterol, low density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, very low density lipoprotein (VLDL) cholesterol, and triglycerides), Homeostatic Model Assessment HOMA, bone density (T and Z scores), levels were all measured in serum . The enzyme-linked fluorescence assay (ELFA) technique was used to detect serum 25(OH)D using the auto analyser VIDAS (Marcy l'Étoile, France). The vitamin D levels were classified as normal (≥30 ng/mL), inadequate (>20 to 29.9 ng/mL), and deficient (≤20 ng/mL) as per Endocrine Society's Clinical Practice Guidelines, 2011.[12]

2.3. Statistical analysis

The statistical analysis was performed using SPSS v 18 (IBM Corp., Armonk, NY, USA). The comparison of biochemical parameters between obese and non-obese group was performed using Student's t-test. The relationship between serum vitamin D levels, lipid profiles, and other clinical factors was estimated using simple linear regression analysis A p value <0.05 was considered as statistically significant.

3. Results

The overall demographics and biochemical profile of study participants (n=83) encompassing obese and non-obese individuals were shown in Table 1.

In this study the age, systolic and diastolic blood pressure among the obese and non-obese individuals was found to be non-significant. There was significant (p<0.0001) increase in height among the non-obese subjects as that of the obese subjects (157.75 ± 5.5 vs 151.44 ± 7.12 cms). Further, weight, BMI, vascular stromal fraction (VSF) and total body Fat% (TBF) was shown to be substantially elevated in obese individuals than in non-obese ones (Table 2).

T-scores and Z-scores were used to report DEXA results. Obese participants had significantly higher T-scores and Z-scores than non-obese ones in this research. Furthermore, obese patients displayed significantly higher insulin levels, blood sugar levels, and Homeostatic Model Assessment-Insulin Resistance HOMA-IR than non-obese ones. In the meanwhile, vitamin D levels between obese and non-obese patients was found to be non-significant (p=0.14) (20.65± 4.53 vs 22.65± 6.62nmol/L). The results were shown in (Table 3).

Values are represented as mean ± SD. P value <0.05 was found to be significant. The association between vitamin D levels and lipid profiles was evaluated using regression coefficient analysis. The correlation was done based on the various grade of vitamin D levels such as Deficiency <20nmol/L, Insufficiency 20-30nmol/L and Sufficiency >30nmol/L. There was a strong negative connection between triglycerides and vitamin D levels in vitamin D insufficiency.(R=-0.642; p=0.01) and VLDL and vitamin D (R= -0.504; p=0.01). Meanwhile, there was no significant correlation between total cholesterol, HDL, LDL and Non-LDL and vitamin D level. In Vitamin D insufficiency, there was positive correlation between total cholesterol and found to be significant (R=0.566; p=0.001), Non-LDL (R= 0.729; p=0.000) and vitamin D levels.

In Vitamin D sufficiency, there was a substantial negative association between total cholesterol, positive correlation between triglycerides, HDL and VLDL and vitamin D level respectively (Table 4).

Further, we have observed non- significant correlation between vitamin D level and Z scores and T-scores. However, there was significant negative correlation between Z score and Vitamin D insufficiency (R=-0.536; p=0.002) (Table 5).

In this study, there was no significant correlation between Insulin, HOMA-IR and blood glucose level and Obese and Non-Obese subjects". The results were shown in Table 6.

The correlation regression analysis reveals that there was negative association between vitamin D levels and Total abdominal adipose tissue (TAAT) in obese subjects (Table 7).

4. Discussion

Vitamin D is a multipurpose nutrient. Vitamin D deficiency has been linked to a variety of health problems, including CVD.[13] Dyslipidaemia, which is defined as an increase in

Table 1: Demographics and clinical characteristic of the study population

	N	Mean	Std. Deviation
Age	83	47.1084	10.01586
SBP	83	126.7229	15.35222
DBP	83	76.9880	8.58742
Ht	83	152.9639	7.26535
Wt	83	67.1892	11.41502
BMI	83	28.3973	4.14505
VSF	83	11.6325	4.50547
TBF%	83	39.2120	4.43917
T Score	83	2.3892	0.86814
Z Score	83	1.9133	1.01258
Vit.D	83	22.0992	6.21649
Insulin	83	16.8005	7.34795
BSL	83	112.6867	25.27648
HOMA-IR	83	4.9004	2.68789
TC	83	174.9157	28.26711
TG	83	119.1807	38.54682
HDL	83	46.9976	11.53237
VLDL	83	23.8361	7.70936
LDL	83	104.0819	22.43865
Non HDL	83	127.9181	4.17041

Table 2: Comparison of Demographics among the obese and non-obese subjects

Parameters	Non-Obese (n=20)	Obese (n=63)	P-value
Age (Years)	50.00 ± 12.440	46.19± 9.05	0.04
SBP (mm/Hg)	122.90 ± 18.90	127.93 ± 14.00	0.272
DBP (mm/Hg)	71.75± 10.22	78.65± 7.36	0.051
Height (cms)	157.75 ± 5.5	151.44 ± 7.12	<0.0001
Weight (Kgs)	57.60± 4.57	70.23± 11.26	<0.0001
BMI (Kg/m^2)	23.14± 1.48	30.06± 3.20	<0.0001
VSF	6.10 ± 1.27	13.38± 3.65	<0.0001
TBF%	36.23 ± 3.53	40.15 ± 4.29	<0.0001

Values are displayed as mean ± SD. P value <0.05 was denoted as significant.

Table 3: Comparison of Biochemical variables among the obese and non-obese subjects

Parameters	Non-Obese (n=20)	Obese (n=63)	P-value
T-score	1.83 ± 1.01	2.56 ± 0.74	0.002
Z-score	1.17 ± 0.79	2.14 ± 0.96	<0.0001
Vit. D (nmol/L)	22.65 ± 6.62	20.65± 4.53	0.14
Insulin (μIU/mL)	11.59 ± 3.04	18.45 ± 7.55	<0.0001
Blood sugar level (mg/dL)	106.0 ± 9.26	114.80 ± 28.29	0.0327
HOMA-IR	3.06 ± 0.94	5.48 ± 2.80	<0.0001
AST (IU/L)	26.12±2.76	39.76±3.43	<0.0001
ALT (IU/L)	25.87±1.38	41.82±5.65	<0.0001

P<0.05 was considered as significant

Table 4: Correlation between Vitamin D level and lipid profiles

Vitamin D level	Lipid Profiles	Regression Coefficient (R)	p-value
Deficiency <20	TC	0.390	0.063
	TG	-0.642	**0.01**
	HDL	-0.383	0.116
	VLDL	-0.504	**0.01**
	LDL	0.102	0.121
	Non-LDL	0.340	0.087
Insufficiency 20-30	TC	0.566	0.001
	TG	0.186	0.307
	HDL	0.219	0.180
	VLDL	-0.142	0.408
	LDL	0.169	0.510
	Non-LDL	0.729	0.000
Sufficiency >30	TC	-9.357	0.002
	TG	6.640	0.003
	HDL	3.871	0.001
	VLDL	1.21	0.021
	LDL	1.26	0.018
	Non-LDL	-0.890	0.047

P<0.05 was considered as significant

Table 5: Correlation between T and Z Scores and Vitamin D level

Vitamin D level	DEXA Index	Regression Coefficient (R)	P-value
Deficiency <20	T-Score	-0.692	0.188
	Z-Score	0.219	0.672
Insufficiency 20-30	T-Score	0.293	0.084
	Z-Score	-0.536	0.002
Sufficiency >30	T-Score	5.93	0.253
	Z-Score	-5.20	0.304

P<0.05 was considered as significant

Table 6: Correlation between Insulin, HOMA-IR and blood glucose level and Obese and Non-Obese subjects

BMI Category	Parameters	Regression Coefficient (R)	P-Value
Obese	Insulin	0.188	0.495
	HOMA-IR	0.196	0.526
	BSL.	-0.159	0.351
Non-Obese	Insulin	-11.64	0.228
	HOMA-IR	14.26	0.229
	BSL.	-4.58	0.246

P<0.05 was considered as significant

Table 7: Association between vitamin D levels and body fat variables

Parameters	Obese	Nonobese
Body fat (%)	0.016	0.32
Total abdominal adipose tissue (cm^2)	−0.48*	−0.004
Subcutaneous-abdominal adipose tissue (cm^2)	0.069	−0.002
Intra-abdominal adipose tissue (cm^2)	0.014	−0.24

* denotes significant, p<0.05

LDL, a rise in TG, and a reduction in HDL-C, has long been recognised as a CVD risk factor.[14] Vitamin D may have an effect on cardiovascular health via affecting blood lipids. In the present study, the obese patients displayed significant increase in BMI, VSF and TBF% in comparison to the non-obese individuals. Related to our report in a Nigerian study, the BMI is considerably elevated in obese subjects as compared to the control patients.[15]

Obesity and being overweight might strengthen bones, perhaps lowering the incidence of osteoporotic fractures by increasing bone mineral density (BMD), a well-known indication of osteoporosis. In our study, the T and Z scores are greater in obese as that of the non-obese subjects ($p<0.05$) and in both the cases the T and Z scores were in the normal range. Similar to the present study, Salamat et al.[16] reported normal BMD values in subjects with BMI <25 kg/m^2 and BMI >30 kg/m^2, however, the BMD values were lower in subjects with BMI<25 as that of the subjects with BMI >30 kg/m^2. The vitamin D level in obese patients is decreased as compared to non-obese patients, but found to be non-significant (20.65± 4.53 vs 22.65± 6.62nmol/L; p=0.14). Previous reports shows in obese subjects the serum vitamin D levels is 20% lower as compared to the normal individuals.[17] Low level of vitamin D is mainly due to the adverse effect of obesity rather its etiology. Previous genetic study shows that high BMI and genes that provokes obesity reduces serum vitamin D level. However, there is a contrasting report that the decreased vitamin D levels and the genes which predisposes low vitamin D level has only minimum effect on obesity.[18] The other mechanism of decreased vitamin D level in obese subjects might be due to changes in protein binding or increased metabolic clearance.[17]

Further, insulin level and HOMA-IR displayed significant elevation in obese as compared to non-obese subjects. Similar to our report, in a study done by ter Horst et al.[19] the plasma insulin level and HOMA-IR are significantly elevated in obese subjects as compared to non-obese subjects.

In this study based on the vitamin D requirement the patients are classified as Deficiency <20nmol/L, Insufficiency 20-30nmol/L and Sufficiency >30nmol/L. There is a substantial negative association between triglycerides and vitamin D insufficiency in individuals (R= - 0.642; p=0.01) and VLDL (R=-0.504; p=0.01). Our results are in corroboration with Chaudhuri et al.[20] study where there is a significant ($p<0.001$) elevation of triglycerides and VLDL in vitamin D deficiency subjects. Vitamin D status was shown to be substantially linked with the development of metabolic syndrome in another study done in Lebanon [OR:2.496; 95% CI (1.31-4.73); p=0.005)[21] Insulin resistance plays a role in the link between vitamin D and triglycerides. Vitamin D deficiency accelerates the evolution of insulin resistance, which raises VLDL cholesterol and triglyceride levels.[17]

The present study also reported, significant positive correlation in vitamin D insufficiency and cholesterol level (R=0.566; p=0.001). Similarly, Bashir et al.[22] reported that vitamin D insufficiency displays a significant effect on total cholesterol level and it elevates upto two-fold. Low vitamin D levels was associated with a strong negative correlation with total cholesterol and a positive correlation with HDL.Studies show that sufficient vitamin D levels reduce the intestinal fatty acid absorption by increasing the intestinal calcium absorption.[23] By lowering hepatic triglyceride production and release, the increased calcium level lowers blood triglycerides. A study done by Karhapaa et al.[24] displayed significant association of elevated HDL cholesterol with sufficient vitamin D level. Further, vitamin D levels are also linked to lower total cholesterol and triglycerides, according to the researchers.

In our study, only vitamin D insufficiency subjects displayed significant negative correlation with Z score (R= -0.536; p=0.002). However, in contrast Kirba et al.[25] showed no correlation between the serum vitamin D levels and BMD.

In addition, we have observed no significant correlation between Insulin, HOMA and BSL in obese and non-obese patients. However in contrast, in De Luis et al.[26] study obese persons had greater HOMA-IR levels than people with normal BMI, and there was a strong positive connection between HOMA-IR and BMI.

5. Conclusion

Thus the present study shows that the Vitamin D levels are markedly decreased in obese patients as compared to non-obese individual but it was found to be non-significant. Further, vitamin D deficiency displayed significant association with triglycerides and VLDL level. In addition, vitamin D insufficiency is significantly associated with total cholesterol and HDL levels. Vitamin D level has no significant effects on BMD based on Z and T scores.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Cite this article: Borgaonkar K, Patil R. Study of biochemical parameters along with correlation of Lipid profile and Vitamin D in obese and non-obese subjects. *Panacea J Med Sci* 2024;14(2):360-365.