Serum Lipid Profile Level among Patients With Vitamin D Deficiency

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Abstract:

The aim of this study is to assess the impact of vitamin D deficiency on lipid profile among patients. The study included 71 patients, 30 healthy patients classified as controls and 41 patients suffering from vitamin D deficiency classified as the case group. Vitamin D levels were stratified into three ranges: deficient (< 10ng/ml), insufficient (10-20 ng/ml), and sufficient (>20ng/ml) among which there was high significant difference among the levels of cholesterol (TC), and triglycerides (TG) between cases and controls, and there was no significant difference in levels of high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), and TG: HDL-C ratio between cases and controls. We found insignificantly negative correlation between the serum levels of total cholesterol, triglycerides, HDL-C and TG: HDL-C ratio, and vitamin D, in addition to insignificantly positive correlation between LDL-C level and vitamin D. The study concluded that serum cholesterol and triglycerides were significantly higher among patients suffering from vitamin D deficiency compared to control. Hypercholesterolemia and hypertriglyceridemia increasedrisk of Dyslipidemia like atherosclerosis , coronary artery disease (CAD), coronary heart disease, and cerebral ischemic.

Keywords :vitamin D deficiency ;total cholesterol ; triglycerides ;high density lipoprotein cholesterol , and low density lipoprotein cholesterol.

مستوى تركيز الدهون لدى المرضى الذين يعانون من نقص فيتامين د

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المستخلص:

الهدف من هذه الدراسة تقييم تأثير نقص فيتامين د على مستوى الدهون لدى بعض المرضى. تضمنت الدراسة 71مريضاً ، تم تصنيفهم إلى 30 مريضاً لا يعانون من نقص فيتامين د كمجموعة ضابطة و 41 مريضاً يعانون من نقص فيتامين د كمجموعة للحالة المرضية ، وتم تصنيف الأشخاص إلى ثلاثة مستويات حسب كمية فيتامين د حيث كان هناك ارتفاع ذو دلالة احصائية في مستوى الكولسترول (TC) والدهون الثلاثية (TG)في الحالات المرضية (المرضى الذين يعانون من نقص فيتامين د والمرضى الذين ليس لهم مقدار كاف من فيتامين د) مقارنة بالمجموعة الضابطة ولا توجد فروقات ذات دلالة احصائية بين الحالات المرضية والمجموعات الضابطة في مستويات كلا من كولسترول البروتين الدهني عالي الكثافة (HDL-C) ، كولسترول البروتين الدهني منخفض الكثافة (LDL-C) **والنسبة**(TG/HDL-C) . **وجدنا ارتباط سلبى ليس له دلالة احصائية بين مستوى كلا من** (TC) ، (TG) ، (HDL-C) **و** (TG/HDL-C) **وفيتامين د , وارتباط إيجابي ليس له دلالة احصائية بين مستوى** (LDL-C) **وفيتامين د. خلصت الدراسة على أن الكولسترول والدهون الثلاثية مرتفعة في المرضى الذين يعانون من نقص فيتامين د وهذا يسبب خطورة عسر دهون الدم مثل مرض تصلب الشرايين ، مرض الشريان التاجي, مرض القلب التاجي و مرض نقص التروية الدماغية.**

الكلمات المفتاحية : نقص فيتامين د , الكولسترول , الدهون الثلاثية , كولسترول البروتين الدهني مرتفع الكثافة وكولسترول البروتين الدهني منخفض الكثافة .

Introduction:

Recently, a large observational study found that vitamin D deficiency is associated with an increased risk of coronary artery disease, diabetes, cardiomyopathy, hypertension, and all-cause death (Vacek et al, 2012). The theory of a relationship between vitamin D and cardiovascular disease (CVD) and mortality is not new (Dobnig et al, 2008). Vitamin D deficiency is associated with not only CVD disease itself but also CVD risk factors (Martini &Wood, 2006). Low vitamin D levels could result in dyslipidemia and lipid abnormalities—that is, an increase in triglycerides (TG), total cholesterol (TC), and low-density lipoprotein cholesterol (LDL-C) levels and a decrease in high-density lipoprotein choles-

terol (HDL-C) .Dyslipidemia and lipid abnormalities have been identified as important risk factors for atherosclerosis and CVD disease in adulthood (Potenza & Mechanick, 2009) .Hypercholesterolemia and hypovitamin D have a common synthetic pathway, because if there was a defect in LDL receptors and thus a defect in cholesterol uptake, so cholesterol level in the blood will be increased and vitamin D will be decreased, so LDL cholesterol is a precursor of previtamin D (Choi et al, 2011). Vitamin D reduces the synthesis of triglycerides in the liver and their secretion (Asma & Naser, 2018). The mechanism is to reduce triglycerides via PTH suppression (Choi et al, 2011). The atherogenic index of plasma (AIP), expressed as log [TG/HDL-C], could be an excellent predictor of levels of sdLDL-C, has been reported to correlate to atherosclerosis and coronary artery disease (CAD) (Frohlich & Dobiasova, 2003). The potential of AIP to predict CVD risk has been shown in some studies (Frohlich & Dobiasova, 2003; Onat et al, 2010). The main aim of this research study is to determine the effect of vitamin D deficiency or insufficiency on serum levels of cholesterol, triglycerides, LDL-C, HDL-C, and TG: HDL-C ratio. The specific objectives of this present research study are to demonstrate the effect of low levels of vitamin D on lipid profile.

Materials and Method:

A total of seventy-one patients who applied to the outpatient clinics of Al -zaytouna specialized hospital between the years of 2019 and 2020 were included in our prospective, interventional study. Their ages were between 18 to 85 years and they were coming from different parts of Sudan. Al -zaytouna specialized hospital located in Khartoum State, Khartoum is the largest city of the country it had an estimated total population of approximately 6 million people according to the national population census in 2009. The subjects were divided into two main groups, group one (41 patients) represented the case group (Their mean age was

41.24 ± 18.60 years). The second group (30 patients) was chosen as controls (Their mean age was 43.80 ± 15.39 years). The case study group was classified into three sub-groups basis on the level of vitamin D.

Designing Study

This is a case-control study with sequential recruitment of study participants with deficient and insufficient vitamin D, diagnosed by physicians depending on laboratory investigation, and those without the disease who served as control. The laboratory tests for the biochemical parameters were conducted to assess the biochemical status and change in patients with vitamin D deficiency and insufficiency. These tests include serum concentrations of 25(OH)D, total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C).

Blood Collection

About (4 ml) of samples were collected from the participants by using venipuncture into a dehydrated test tube (4 ml) utilizing a 5 ml nontoxic ,pyrogen-free, sterilized disposable syringes. The blood samples were then centrifuged at ٢٥٠٠ rpm for 5 minutes, and serum was transmitted into separate Eppendorf tubes utilizing sterile micropipettes after that they stored in the freezer at about −35°C for analysis of serum 25(OH)D ,total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C,) and low-density lipoprotein cholesterol) LDL-C.

Methods

Vitamin D was measured according to the a competitive chemiluminescence immunoassay (CLIA) technique method described by (Schleicher & Pfeiffer, 2013).

Total cholesterol and HDL-C were measured according to the precipitant method with magnesium ion and phosphotungstic acid as a precipitated (Burstein et al, 1980). Triglycerides was mea-

sured according to the enzymatic method described by (Warnick et al, 2008) .

LDL-C was measured according to the method using the Friedewald equation (LDL-C = TC − HDL-C − TG/5) described by (Friedewald et al.,1972).

Ethical Consideration

Ethical clearance was obtained from the Faculty of postgraduate, university of Al-Neelain. Administrative clearance was obtained from the the Southwest region and the Directors of the participating hospitals. Furthermore, authorization was obtained from the chiefs and quarter heads of the communities.

Statistical analysis

Data were analyzed using the statistical software package IBM SPSS statistics for windows, version 16 (SPSS Inc., USA). The normality of the continuous data was evaluated using the Kolmogorov-Smirnov test. Data were expressed as percentages, mean ±standard deviation of the mean (SDM). Analysis of Variance (ANOVA) was used to assess the difference between group means of parametric variables. The relationship between variables was analyzed utilizing Pearson's or Spearman's correlation coefficient. Statistical significance was designated as $p \leq 0.05$.

Results :

Patients suffering from insufficient and deficient vitamin D

Seventy-one adults who participated in the study are classified according to the amount of vitamin D into three groups based on their vitamin D levels: group one was deficient in vitamin D represented 21.13% (n=15), group two was insufficient in vitamin D represented 36.62% (n=26) and group three was healthy (not suffering from insufficient and deficient in vitamin D) represented 42.25% (n=30).

Table (1) shows that the mean value of total cholesterol

level mg/dl was (142.73± 31.05) among healthy patients, and (158.40± 38.76) among patients suffering from vitamin D deficiency. There were higher significant differences between the deficient group compared with the control group.

In addition, the mean value of triglycerides level mg/dl was (105.87± 16.37) among healthy patients, and (128.33± 44.53) among patients suffering from vitamin D deficiency. There were higher significant differences between the deficient group compared with the control group.

The mean value of HDL-C level mg/dl was (38.63± 3.22) among healthy patients, and (39.88± 5.63) among the patients deficient vitamin D. There were no significant differences between the deficient group compared with the control group.

LDL-C mean level mg/dl was (94.23± 17.89) among healthy patients, and (95.94± 28.44) among patients suffering from vitamin D deficiency. There were no significant differences between the deficient group compared with the control group.

Mean value of TG: HDL-C ratio level mg/dl was (2.77± 0.53) among healthy patients, and (2.71± 0.92) among patients that suffering from vitamin D deficiency. There were no significant differences between the deficient group compared with the control group.

The association between serum vitamin D concentration and lipid profile

Table (2) indicates that vitamin D deficiency level shows insignificant negative correlation with cholesterol (r = -0.233 and P = 0.051), triglycerides (r = -0.057 and P = 0.635), high density lipoprotein- cholesterol (r = -0.082 and P = 0.497), and ratio of TG: HDL-C (r = -0.042 and P = 0.729). In contrast, table (2) shows insignificant positive correlation between vitamin D deficiency, and low density lipoprotein- cholesterol (r = 0.032 and P = 0.790).

Table (1): shows total cholesterol (TC), triglycerides (TG), High density lipoprotein- cholesterol {HDL-C}, Low density lipoprotein- cholesterol (LDL-C), and TG/HDL-C ratio.

Measurement (mg/dl)	Control group >20ng/ml (n=30)	Insufficiency group ng/ml (10-20) (n=15)	Deficiency group 10ng/ml > (n=26)	P-value
TC	31.05 142.73±	32.74 146.92±	38.76 158.40±	0.013
TG	16.37 105.87±	28.36 105.58±	44.53 128.33±	0.030
HDL-C	3.22 38.63±	3.96 38.89±	5.63 39.88±	0.553
LDL-C	17.89 94.23±	22.66 93.46±	28.44 95.94±	0.942
TG: HDL-C	0.53 2.77±	1.32 3.38±	0.92 2.71±	0.052

* The mean difference is significant at the 0.05 level. Data are expressed as Mean± SD

Table (2): shows Pearson's correlation coefficients (r) for serum lipid profile and vitamin D

Parameters	(Correlation Coefficients (r	P-value
Total cholesterol	-0.233	0.051
Triglycerides	-0.057	0.635
HDL-Cholesterol	-0.082	0.497
LDL-Cholesterol	0.032	0.790
TG: HDL-Cholesterol		0.729
P value < 0.05 is considered significant		

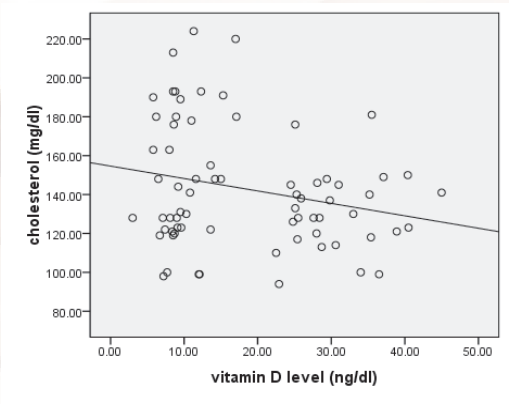
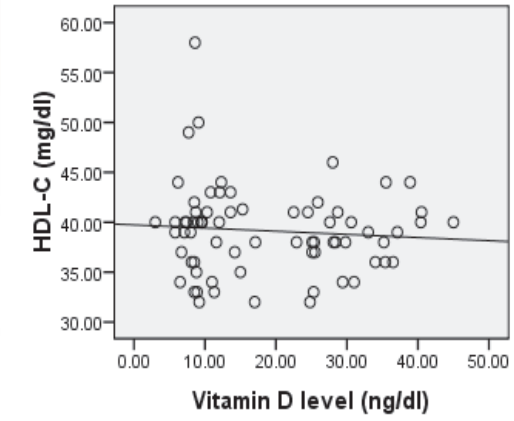


Figure (1). Serum vitamin D level in relation to Serum TC.



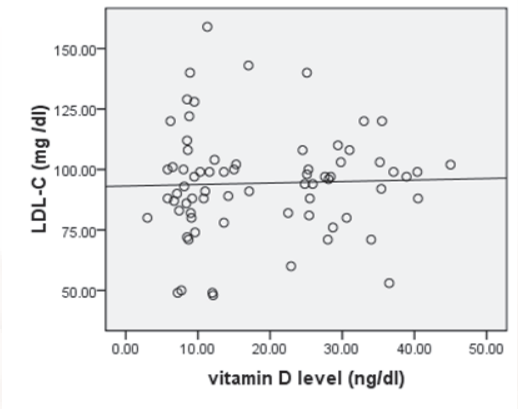


Figure (3) . Serum vitamin D level in relation to Serum HDL-C.

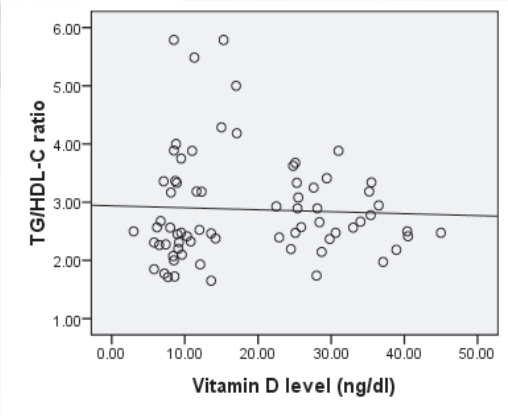


Figure (5) . Serum vitamin D level in relation to Serum TG/ HDL-C ratio.

Discussion

The result illustrates that the Cholesterol level is increased significantly in subjects that deficient in vitamin D (P = 0.013). This finding is in agreement with those results that were obtained by (Karhapää et al, 2010). Photo metabolism may be the mechanism involved for this as the absence of sunlight causes squalene exposed skin to divert for cholesterol formation instead of forming 7 dehydrocholesterol and vitamin D (Choi et al, 2011).

As shown in Table (1), high level of triglycerides is observed with low level of vitamin D in the deficient vitamin D patients (P= 0.030). Hypertriglyceridemia was associated with low serum level of vitamin D in patients suffering from vitamin D Deficiency and insufficiency which consistent with the result that was reported by (Mohammed, 2018). A possible mechanism of an increased level of serum triglycerides associated with low vitamin D levels could be that vitamin D leads to an increase in levels of serum calcium by increasing its intestinal absorption. This elevated calcium reduces hepatic triglyceride formation and secretion, finally decreasing their levels in the blood. Insulin resistance is also known to be present in Vitamin D deficiency, which leads to raise the levels of serum triglycerides and very LDL-C (Lacour et al, 1980).

As shown in the results of this study, there are insignificant differences in the mean level of HDL-C between patients with vitamin D deficiency compared with control group (P=0.553). These findings are agreed with the results reported by (Steger, 2013). Despite, having no significant differences in HDL-C, its levels are low in both healthy patients and patients suffering from vitamin D deficiency. A low level of high-density lipoprotein cholesterol (HDL-C) is a strong an independent predictor of CVD (Tanne et al, 1997).

The data of the results showed insignificant differences in LDL-C levels between cases and controls (P = 0.942). These findings are similar to those results obtained by (Abed El-Raoof, 2004).

The results also showed that, there were insignificant differences in the mean level of TG/HDL-C ratio in patients suffering from vitamin D deficiency compared with the control groups (P=0.052). These findings are similar to those results obtained by (Wang et al, 2016). Patients suffering from vitamin D insufficiency have a higher level of TG: HDL-C ratio than controls. Elevating TG and/or decreasing HDL-C could cause AIP to rise. Hypertriglyceridemia and /or hypo-HDL cholesterolemia as special types of dyslipidemia are thought to be high-risk factors for atherosclerosis and coronary artery disease (CAD) (Tuteja & Rader, 2014; Rosenson et al, 2015). The AIP is classified as more useful marker of atherogenicity and cardiovascular risk than single LDL-C or TC (Lamarche et al, 2001; Dobiasova & Frohlich,2001).

Table (2), and shape (1) showed an insignificantly, negative correlation between the serum levels of total cholesterol and vitamin D level (P =0.051). This finding is agreed with the results reported by (Nouri et al,2017). In addition, table (2), and shape (2) also showed an insignificantly, negative correlation between TG and vitamin D levels (P =0.635). These findings are agreed with the results obtained by (Steger, 2013). There is a non-signif-

icant negative association with serum level HDL-C and vitamin D deficiency, as indicated in table (2), and shape (3) (P = 0.497). This finding is agreed with results reported by (Steger, 2013). Table (2), and shape (4) is also showed a non-significantly positive association with serum level of LDL-C and vitamin D deficiency (P=.0.790) Jorde and Grimnes reviewed five of the seven papers reporting LDL, found positive associations, only one being statistically significant, while three reported negative associations, with one being significant (Jorde & Grimnes, 2011). Table (2), and shape (5) also revealed an insignificantly negative association with serum level of TG/ HDL-C and vitamin D deficiency (P=0.729). Jeana found negative association between TG /HDL –C ratio and vitamin D , but was statistically significant (Jeana, 2022).

Conclusion:

The results concluded that there was a significant difference in TC and TG between cases and the control groups according to the amount of vitamin D deficiency, whereas there was no significant difference in HDL-C, LDL-C , and TG/HDL-C ratio between cases and control groups according to the status of vitamin D deficiency. Vitamin D levels insignificantly associated with the serum TC,TG , HDL-C, LDL-C, and TG/HDL-C .Finally, vitamin D deficiency associated with Dyslipidemia which including hypercholesterolemia and hypertriglyceridemia that causes a danger to people's health. It is also an important risk factor for the occurrence of cerebral ischemic , coronary heart disease, atherosclerosis and coronary artery disease (CAD).

Recommendations:

Frequent monitoring of vitamin D levels particularly in individuals with family history of lipid disorders must be done. Moreover, measurement of serum lipid profile should be introduced to the patients suffering from vitamin D deficiency and insufficiency in order to avoid the risk of lipids disorders.

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