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Dyslipidemia and Vitamin D Status in Diabetic Patients

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ABSTRACT

Background: Dyslipidemia is one of the most common metabolic syndrome among diabetic patients due to several factors include insulin insufficiency, resistance, and central obesity. Furthermore both vitamin D deficiency and diabetes are most public health worldwide problems. Therefore the aim of the present work to study the dyslipidemia and vitamin D status in diabetes patients and also to study the relation between vitamin D status and lipid profile in diabetic patients.

Methods: A Cross sectional study conducted on randomly selected diabetic patients whether have vitamin D deficiency with dyslipidemia, vitamin D deficiency with no dyslipidemia or dyslipidemia with no vitamin D deficiency. A total sample 165 patients enrolled in the study with serum lipid profile, vitamin D and glycemic control measured at beginning and end of the study. The data analysis was done through Chi-square or T test at $\alpha < 0.05$.

Result: The data collected on 165 patients revealed that, patients aged 41-60 years were most common, and female gender was twice as male. This study include both types of diabetes with vitamin D deficiency and dyslipidemia or vitamin D deficiency with no dyslipidemia or dyslipidemia with not vitamin D deficiency as control. Therefore, the result of this work confirmed that vitamin D deficiency significant implicated in elevated serum levels of TG, TC, LDL, VLDL, FPG and HbA1C ($P < 0.05$). However, vitamin D deficiency has linked to slight increased serum HDL levels. In compared to man, vitamin D deficiency linked significantly to dyslipidemia and abnormal high levels blood glucose and HbA1C par in women.

Conclusion: The present study revealed that, vitamin D deficiency associated negatively with serum levels of TC, TG, VLDL, LDL, FPG and HbA1C whereas the deficiency of vitamin D linked to elevated HDL levels. In gender distribution lower vitamin D values associated with elevated serum FPG, HbA1C, lipid profile with exception HDL in women. The data of this study suggested that, diabetic patients with dyslipidemia may improve their lipid profile and glucose hemostasis through vitamin D supplementation.

KEYWORDS: Deficiency; Dyslipidemia; FPG; Hba1c; Lipid Profile; Vitamin D.

INTRODUCTION

Dyslipidemia is most common metabolic syndrome among diabetic patients due to several factors include insulin insufficiency, resistance, and central obesity [1]. Vitamin D deficiency and diabetes mellitus are two common public health problems [2]. Recently Vitamin D deficiency considered one of intense interest topic, and is common prevalent affect all ages, races, geographical regions, and socioeconomic strata. Deficiency of vitamin D can contributes to many conditions, including among which diabetes mellitus [3,4].

Vitamin D receptor and inactive form 1-α hydroxylase, which is essential for the synthesis the active form of the hormone 1,25 (OH)2D (1,25 – di-hydroxy vitamin D), which subsequently activate pancreatic β-cells via insulin receptor expression and insulin-induced glucose transport in vitro, it also directly regulates fatty acid metabolism in skeletal muscle and adipose tissue, and low concentrations of vitamin D are associated with impaired insulin sensitivity, whereas substitution with vitamin D in the deficient state improves insulin sensitivity [5].

Recently, it has been proved that vitamin D deficiency and insufficiency are associated with many chronic diseases including cancers, cardiovascular diseases, metabolic syndrome, infectious and autoimmune diseases [6]. A possible mechanism of action is

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to induce insulin secretion and increase insulin sensitivity. Vitamin D is thought to increase insulin secretion by affecting nuclear receptors in pancreatic beta cells [7].

Several studies found that positive correlation between vitamin D levels and insulin sensitivity. However, there was also a positive correlation between vitamin D levels and insulin sensitivity in subjects with normal glucose tolerance [8,9].

It has been confirmed that lowering of serum cholesterol results in a reduction in cardiovascular Morbidity. One of possible mechanism could vitamin D influence CVD through affecting lipid profile [10]. Previous study have suggested that there is a relationship between 25 (OH)D levels and serum lipids. However, the results are inconsistent [10]. A cross-sectional study by Jorde et al showed that there were positive associations between serum25 (OH)D levels and TC, HDL-C and LDL-C and a negative association between serum25(OH)D and TG among population [11]. Furthermore, data from the another study conducted by Gaddipati et al suggested that serum25(OH)D levels are negatively associated with TC, TG and LDL-C, and positively associated with HDL-C [12]. In addition, changes in LDL (sdLDL) is found to have great adherent to arterial wall compared to LDL-C. [TG/HDL-C]), as sdLDL-C is good predictor and has been reported to correlate to atherosclerosis [13].

It was suggested that vitamin D has both direct and indirect effects on modifying the lipid profile and that is one of the proposed mechanisms for the relationship between vitamin D deficiency and CVD[14].

Due to dyslipidemia is most common among diabetic patients and vitamin D status could be a part for this metabolic syndrome and not received enough of challenges and therefore, the aim of the present work is to study the dyslipidemia and vitamin D status in diabetes patients and also to study the relation between vitamin D status and lipid profile in diabetic patients.

MATERIALS AND METHODS

Study design and sample size

A Cross sectional study conducted on randomly selected diabetes patients from diabetic center from beginning of November 2020 to the end of April 2021 the target groups those diabetes patients either have vitamin D deficiency and dyslipidemia, vitamin D deficiency and no dyslipidemia, or dyslipidemia with no vitamin D deficiency. The total number of patients selected randomized were 165 by which 110 women and 55 men. The average ages of patients were 45 years old with the minimum age 18 and maximum age 70 years old. Furthermore, this study included both types of diabetes mellitus but the sample size for T1DM was so small numbers.

Study procedures

The patients in this study selected randomly and followed for 6 months and categorized as following:

61 Diabetes patients have vitamin D deficiency and dyslipidemia (group 1)

33 Diabetes patients have vitamin D deficiency and no dyslipidemia (group 2)

71 Diabetic patients have dyslipidemia and no vitamin D deficiency (group 3)

The patients in this study were either on vitamin D supplementation nor on lipid lowering agents and selected based on age and gender matching and no treatment has been initiated. The patients were also followed and contacted to provide the last values obtained for lipid profile, vitamin D status, FBS and HbA1c at the end of the study.

Biochemical investigation.

Serum lipid profile, vitamin D levels, Fasting blood glucose (FBG or FPG) and HbA1C status have been measured at the beginning and end of study. Therefore, the mean ± SD were calculated and presented in table 2 as overall mean.

Questionnaires

Pre-design questionnaire were validated and contain number of questions with 4 sections and 20 questions related to personal information, demographic data, types of diabetes, biochemical investigation include vitamin D and lipid profile.

Ethical consideration

This study was approval by the local Ethics Committee of the Libyan international medical university (LIMU). Informed written consent was obtained through a consent form that was given to the participants along with the questionnaire.

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Statistical analysis

The data from the questionnaires was exported to SPSS v.22 and Epi-info for complete analysis. Statistical analysis was carried out for the complete sample which were created according to measurements in which frequencies and percentag used. To determine the differences regarding each categorical variable in the groups, T test or Chi-Square test was performed $p \leq 0.05$ was considered to be statistically significant.

RESULT

The data collected on 165 diabetic patients either have vitamin D deficiency and dyslipidemia, vitamin D deficiency and no dyslipidemia or dyslipidemia with no vitamin D deficiency, 61, 33 and 71 respectively. The average age of the patients were 45± 6 years old with the significant predominant ages found 41-60 years old 58.2% (*P* =0.001) followed by age groups above 60 years old 34.5%, and the age groups between 18-25 years old being the least 2.42% (Figure 1). In regarding the gender distribution as shown in the figure 2, female were shown significant twice than male 66.7% and 33.3% respectively. Based on the categorized of patients according to types of diabetes found that majorities of patients have type 2 diabetes mellitus (T2DM) 97% and approximately 3% have type 1 diabetes mellitus (T1DM) (Figure 3).

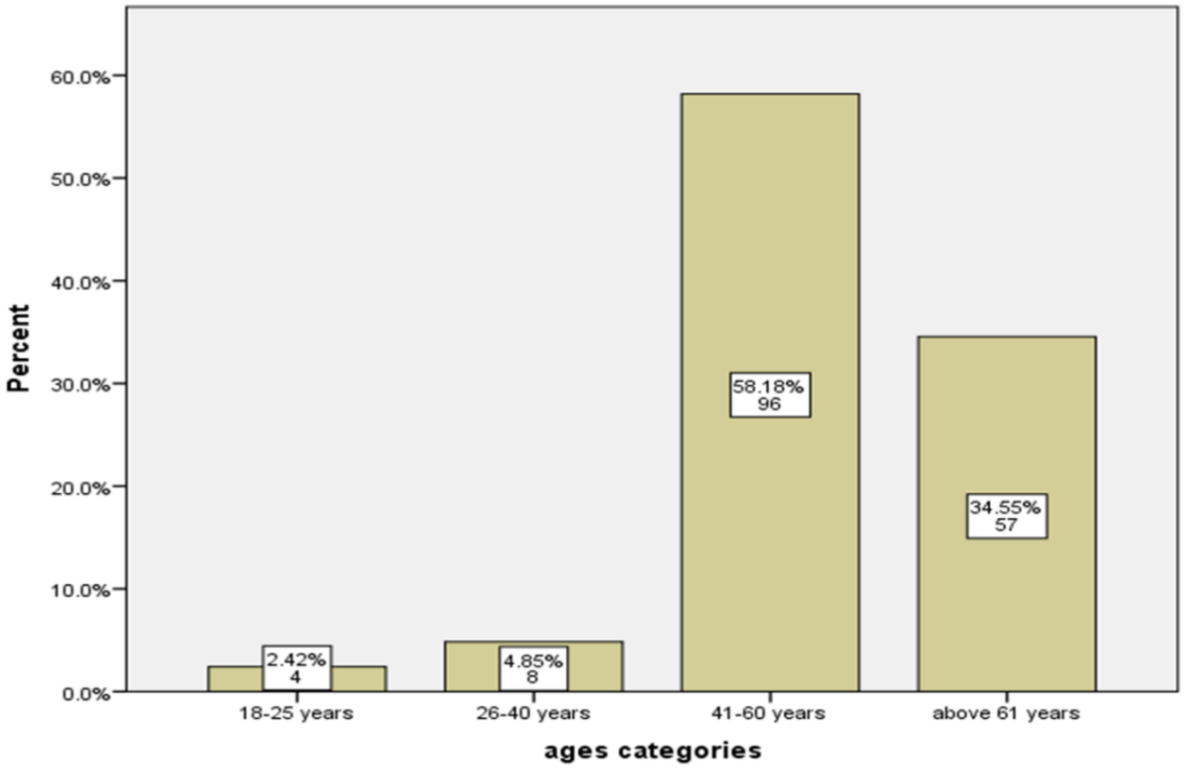

Figure 1: Age distribution of the patients.

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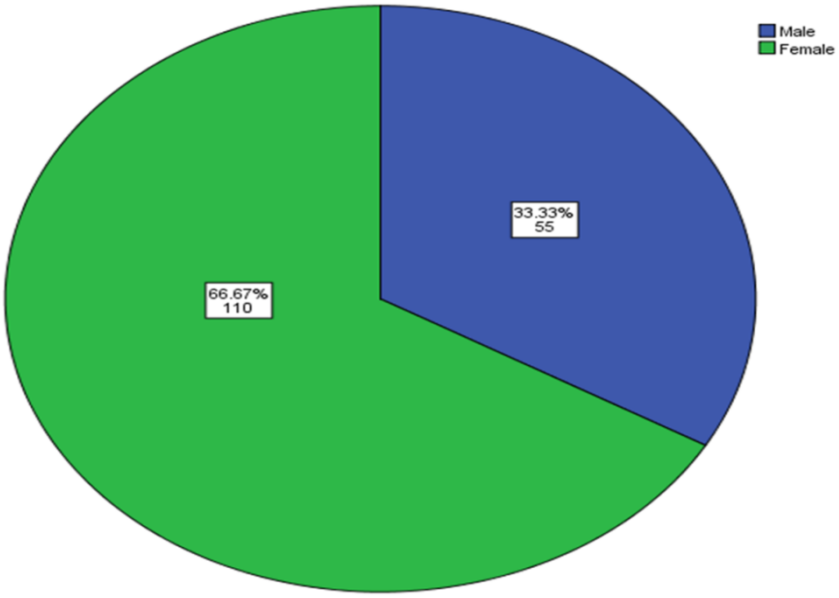

Figure 2: Gender distribution of the patients.

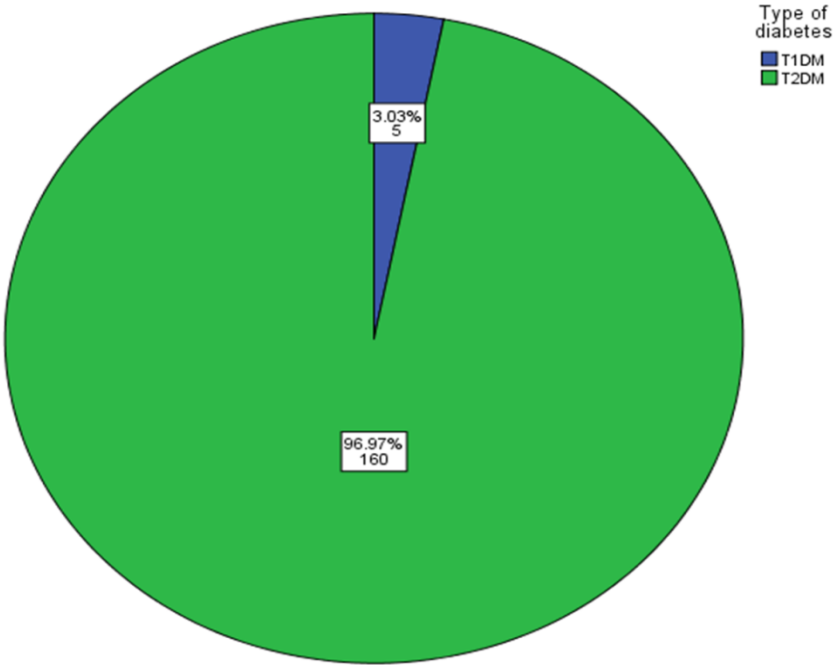

Figure 3: Types of diabetes

Data on Table 1 shown the patients categorization, in which three groups of patients involved in the study. 61 (37%) of patients were diabetes patients have vitamin D deficiency and dyslipidemia, 71 (43%) of patients were diabetic patients have dyslipidemia and no vitamin D deficiency and the last group was diabetes patients have vitamin D deficiency and no dyslipidemia which represent about 20% (33) (Table 1). Furthermore, serum parameters were investigated as shown in table 2, Vitamin D deficiency implicated dyslipidemia include elevated Serum level of cholesterol, TG, LDL and VLDL even in the diabetic patients with no dyslipidemia. Furthermore, , serum HDL shown relationship with vitamin D deficiency in which deficiency of vitamin D associated with slight

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increase in HDL levels. In addition, increased levels of fasting blood glucose and HbA1C among have been noticed in both diabetic patients with vitamin D deficiency with dyslipidemia or not. Common feature identified from table 2 was the dyslipidemia among diabetic patients. Regarding gender distribution among dyslipidemic and vitamin D deficiency diabetes patients revealed that female patients significantly have higher serum parameters of lipid profile, fasting blood glucose and HbA1C than male (P< 0.05) (Table 3).

Table 1: Patients categorization and groups

	N	N %
Diabetes patients have vitamin D deficiency and dyslipidemia	61	37.0%
Diabetes patients have vitamin D deficiency and no dyslipidemia	33	20.0%
Diabetic patients have dyslipidemia and no vitamin d deficiency	71	43.0%
Total	165	100.0%

Table 2: Serum parameters and patients categorization:

Serum parameters	**Patients categories**			**P values**
	Diabetes patients have vitamin D deficiency and dyslipidemia (group 1)	**Diabetes patients have vitamin D deficiency and no dyslipidemia (group 2)**	**Diabetic patients have dyslipidemia and no vitamin D deficiency (group 3)**	
	Mean± SD	**Mean± SD**	**Mean± SD**	
Vitamin D (ug/dl)	**8.79± 1**	**13.00±3**	**35.±4**	
Cholesterol (mg/dl)	**260±19**	**208±22**	**218±9**	**0.00**
TG (mg/dl)	**252.5±12**	**155±12**	**175±11**	**0.001**
HDL(mg/dl)	**52±4**	**58±3.4**	**45±6**	**0.044**
LDL(mg/dl)	**183±22**	**137±9**	**167±9**	**0.001**
VLDL(mg/dl)	**54±8**	**29±4**	**35±5**	**0.02**
FBG(mg/dl)	**188.13±12**	**175.21±6**	**159.95±20**	**0.04**
HB1C%	**9.4±1**	**8.5±0.7**	**7.5±0.6**	**0.01**

T test was performed to compare the mean among diabetic patients with dyslipidemia only to the other counterparts in which at α< 0.05 considered significant.

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Table 3: Gender distribution among patients with dyslipidemia and vitamin D deficiencies:

Serum parameters	Gender		P values
	Men	Women	
	Mean± SD	Mean± SD	
Cholesterol (mg/dl)	174±33	195±23	0.00
TG (mg/dl)	131±13	150±22	0.03
HDL(mg/dl)	54±8	44±10	0.04
LDL(mg/dl)	90±12	118±23	0.001
VLDL(mg/dl)	26.1±7	30±5	0.043
FBG(mg/dl)	115.38±11	192.36±22	0.000
HB1C%	7.1±0.5	8.6±1	0.02

T test was performed to compare the mean among gender of diabetic patients with dyslipidemia and vitamin D deficiency in which at $\alpha < 0.05$ considered significant.

DISCUSSION

Dyslipidemia is most common metabolic syndrome among diabetic patients due to insulin insufficiency. Vitamin D has been shown play a role in diabetes mellitus development and implicated in dyslipidemia [15].

The present study revealed that vitamin D deficiency and dyslipidemia are most common among diabetic patients and this was also established in number of studies [16,17]. In the present work, vitamin D deficiency implicated either in elevated serum cholesterol, TG, VLDL and LDL in both diabetic patients with vitamin D deficiency and dyslipidemia or diabetic patients have vitamin D deficiency with no dyslipidemia. In the study conducted by Yang et al found that vitamin D was negatively correlated with FPG, TG and TC [17]. Furthermore the previous studies have shown that a close relationship between vitamin D levels and glycolipid metabolism in which the most observational studies confirmed that vitamin D was negatively correlated with FPG [18] TG [19] TC [20] LDL-C [21] and these studies were consistent with the present work. However, in the present work increased serum level of HDL was associated with vitamin D deficiency even in diabetic patients with vitamin D deficiency and no dyslipidemia, and this result was disagree with the previous works of Jiang et al [15] and Lue et al [22] in which in their finding shown that vitamin D deficiency has positively associated with HDL levels.

On the other hands, study carried out by Szternel et al [23] showed that serum vitamin D level was associated with 0.015 mmol decreased in HDL. For FPG and HbA1c similar result has been found in the previous works [24, 25]. Furthermore, vitamin D deficiency was associated with dyslipidemia even in patients who did not have dyslipidemia. Similarly, have been confirmed in studies conducted in china [15], in Saudi [26] India [27] but the previous aforementioned studies indicated that HDL positively correlated with HDL cholesterol level and this finding were disagree with the present result in which deficiency led to slight increase in serum HDL. Interestingly, the increment level of HDL in vitamin D diabetes patient whether do they have dyslipidemia or not could highlighted new finding.

Regarding the gender distribution, vitamin D deficiency and dyslipidemia, the current work revealed that, female gender have more complicated dyslipidemia and higher levels of FPG and HbA1C than male. In contrary to the literature there was limited studies compared such finding, in which study conducted in Saudi Arabia [28] found that women with vitamin D deficiency has higher levels of TG than man and man has higher HDL than women and this finding was on non-diabetic patients. According to our knowledge no further studies have been found. The finding of this work could explained in part due to adiposity in the women, in which sedentary life style, increased body fat, might led to more insulin resistant which eventually implicated in higher levels of lipid profile, FPG and HbA1C.

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Overall, dyslipidemia was common among diabetes especially T2DM, and vitamin D deficiency implicated in dyslipidemia and elevated levels of FPG, and HbA1C. Furthermore, women found more sufferer from higher levels of lipid profile, FPG and HbA1c than man.

CONCLUSION

Dyslipidemia is the most common metabolic syndrome among diabetic patients. Vitamin D deficiency implicated in elevation Serum cholesterol, TG , LDL and VLDL and inversely relationship with HDL in which vitamin D deficiency may slightly increase HDL levels in both diabetic patients have dyslipidemia and non. Furthermore, Vitamin D deficiency in diabetic patients have great influence on lipid profile even in diabetic patients with no dyslipidemia in which elevated levels of lipid profile but not to the borderline levels. Furthermore, patients with vitamin D deficiency and dyslipidemia or vitamin D deficiency alone have linked to elevated levels of fasting blood glucose and HbA1C. However, the elevated serum lipid profile levels, fasting blood glucose and HbA1C confined mostly to the female gender. The levels of vitamin D are closely related to serum lipids in diabetic patients. Although vitamin D deficiency may also be associated with the increased risk of dyslipidemias, especially in women. The data of this study suggested that, diabetic patients with dyslipidemia may improve their lipid profile and glucose hemostasis through vitamin D supplementation.

Conflicts of interest

There are no conflicts of interest.

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