

# Relationship between serum vitamin D, adipokines and dyslipidemia in type 2 diabetes mellitus

## Abstract

**Background:** Type 2 diabetes mellitus (T2DM) is related to high risk for cardiovascular disorders especially if it is associated with deficiency of vitamin D.

**Objective:** The aim of our study was to measure the relationship between serum vitamin D, dyslipidemia and adipokines in noninsulin dependent diabetes mellitus (NIDDM).

**Material and Methods:** Two hundred obese subjects (136 women and 64 men) with T2DM, the mean of their body mass index was  $30.84 \pm 3.26$  Kg/m<sup>2</sup> and they are taking oral hypoglycemic agents as pioglitazone and/or metformin who are selected from outpatient diabetic clinic of the King Abdulaziz Teaching Hospital, Jeddah, Saudi Arabia. Renal insufficiency, heart failure, smoking, pregnant women, viral hepatitis and vitamin D supplement were the exclusion criteria in this study. Participants enrolled in one of the 3 groups according to serum vitamin D status: group (I) sufficient vitamin D < 20 ng/ml, group (II) insufficient vitamin D = 20–30 ng/ml and group (III) deficient vitamin D > 30 ng/ml.

**Results:** Concerning variables of the three groups, there were significant higher mean values of TC, TG, LDL and leptin in group (III) than both group (I) and (II) as well as lower mean values of HDL and adiponectin in group (III) than group (I) and (II). However, serum level of vitamin D revealed direct correlation with HDL and adiponectin & a negative correlation with TC, TG, LDL & leptin in all groups.

**Conclusion:** There was relationship between vitamin D status, dyslipidemia and adipokines in Type 2 diabetes mellitus.

**Keywords:** adipokines, dyslipidemia, noninsulin dependent diabetes mellitus, Vitamin D

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**Abbreviations:** ANOVA, analysis of variance; NIDDM, noninsulin dependent diabetes mellitus; T2DM, type 2 diabetes mellitus; HDL, high density lipoprotein

## Introduction

Type 2 diabetes mellitus (T2DM) is a continuous growing medical problem affect about 400 million in 2013, this number will reach about 600 million by 2035, while the developing countries have the highest rate of prevalence for NIDDM.<sup>1</sup> WHO assigned diabetes as an epidemic disease of 21 century.<sup>2,3</sup>

Noninsulin dependent diabetes mellitus (NIDDM) is a principal cardiovascular disorders risk factor for that makes NIDDM a main cause for morbidity and mortality around the globe.<sup>4</sup> Diabetic dyslipidemia, hyperglycemia, insulin resistance, systemic inflammation and abnormal levels of adipocytokines are the main risk factors for cardiovascular dysfunction.<sup>5,6</sup>

Vitamin D regulates many body systems function as bone and adipocyte metabolism.<sup>7,8</sup> Obesity is usually associated with vitamin D deficiency, which induces insulin resistance and increases the risk for NIDDM.<sup>9–12</sup> Vitamin D deficiency, which is considered as a neglected risk factor for cardiovascular disorders among patients with NIDDM<sup>13–15</sup> and affect about billion subjects around the globe.<sup>16</sup>

The aim of our study was to measure relationship between serum

vitamin D, dyslipidemia and adipokines in noninsulin dependent diabetes mellitus (NIDDM).

## Material and methods

### Subjects

Two hundred obese subjects (136 women and 64 men) with NIDDM, the mean of their body mass index was  $30.84 \pm 3.26$  Kg/m<sup>2</sup>, they are taking oral hypoglycemic agents as pioglitazone and/or metformin who are selected from diabetes outpatient clinic of King Abdulaziz Teaching Hospital, Jeddah, Saudi Arabia. Renal insufficiency, heart failure, smoking, pregnant women, viral hepatitis and vitamin D supplement were the exclusion criteria in this study. Participants enrolled in one of the 3 groups according to serum vitamin D status: group (I) sufficient vitamin D < 20 ng/ml, group (II) insufficient vitamin D = 20–30 ng/ml and group (III) deficient vitamin D > 30 ng/ml. All participants signed a consent before sharing in the study.

### Laboratory measurements

Ten milliliters venous blood samples were taken after 10 hours of overnight fasting from all participants to measure:

- a) **Serum vitamin D measurement:** Elisa Kit; DiaSorin, Stillwater, MN, USA was used to measure serum level of vitamin D.

**b) Serum adipokines markers measurement:** Human Leptin Quantikine ELISA Kit (R&D Systems, Minneapolis, MN, USA) was used for assessment of leptin, while Acrp30 Quantikine ELISA Kit (R&D Systems) was used for adiponectin measurement.

### Statistical analysis

Analysis of results was conducted with SPSS version 23 (Chicago, USA). All variables were presented in mean±SD, one way ANOVA was the statistical method used for comparing quantitative variables between groups. Spearman's rank correlation test was used to measure the relation between serum vitamin D and dyslipidemia & adipokines in NIDDM ( $p < 0.05$ ).

## Results

Comparing the baseline criteria revealed no statistical significant differences between groups regarding all variables except systolic blood pressure, diastolic blood pressure, fasting blood sugar, postprandial blood sugar and glycated hemoglobin (HBA1c) where their mean values were greater in group (I) than in both group (II) and (III) as shown in Table 1.

Concerning variables of the three groups, there were significant higher mean values of TC, TG, LDL and leptin in group (III) than both group (I) and (II) as well as lower mean values of HDL and adiponectin in group (III) than group (I) and (II) as shown in Table 2. However, serum level of vitamin D revealed direct correlation with HDL and adiponectin & a negative correlation with TC, TG, LDL & leptin in all groups as shown in Table 3.

**Table 1** Basic criteria of all participants

Variables	Group (I)	Group (II)	Group (III)	P value
Age (year)	53.29±5.16	55.51±4.82	54.98±5.74	0.528
BMI (kg/m <sup>2</sup> )	31.38±3.37	32.41±3.28	30.77±2.95	0.182
Hemoglobin (gm/dl)	12.76±1.21	13.12±1.33	13.46±1.17	0.442
SBP (mmHg)	136.15±16.19	139.54±13.22	137.38±11.68	0.131
DBP (mmHg)	81.31±9.25	80.27±7.24	78.19±6.13	0.165
HBA1c (%)	9.37±2.18	8.69±1.76	7.28±1.54	0.027*
FBS (mg/dl)	186.29±21.57	141.43±16.72	123.42±12.56	0.008*
PPS (mg/dl)	261.36±28.15	203.25±22.68	165.37±11.24	0.006*

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HBA1c, glycated hemoglobin; FBS, fasting blood sugar; PPS, postprandial blood sugar; (\*) indicates a significant difference between groups,  $P < 0.05$ .

**Table 2** Comparison of variables between the three groups

Variables	Group (I)	Group (II)	Group (III)	P value
TC (mg/dL)	196.14±21.27	188.26±18.39	179.35±15.28	0.001*
TG (mg/dL)	121.91±17.22	113.15±13.36	94.27±11.15	0.003*
HDL (mg/dL)	32.86±3.75	38.73±4.14	45.52±6.78	0.009*
LDL (mg/dL)	109.31±14.61	95.86±11.54	89.14± 9.15	0.007*
Adiponectin (µg/ml)	19.62±2.56	22.43±3.21	30.28±3.53	0.028*
Leptin(ng/ml)	32.47±3.14	24.25±2.95	15.71±2.38	0.013*

TC, total cholesterol; TG, triglycerides; HDL-c, high-density lipoprotein cholesterol; LDL-c, low-density lipoprotein cholesterol; (\*) indicates a significant difference between groups,  $P < 0.05$ .

**Table 3** Spearman's rank correlation between vitamin D and lipid profile and adipokines in the three groups

Variables	Group (I)	Group (II)	Group (III)
TC (mg/dL)	-0.638**	-0.646**	-0.722**
TG (mg/dL)	-0.514 *	-0.618**	-0.578*
HDL (mg/dL)	0.613**	0.593**	0.632**
LDL (mg/dL)	-0.582 *	-0.651**	-0.527*
Adiponectin (µg /ml)	0.539*	0.646**	0.674**
Leptin(ng/ml)	-0.654**	-0.718**	-0.698*

Spearman's correlation was used \*,  $P < 0.05$  \*\*,  $P < 0.01$ .

## Discussion

WHO stated that diabetes became an epidemic disease of 21<sup>st</sup> century.<sup>2</sup> However, T2DM is a global cause for morbidity and mortality.<sup>17</sup> There are many studies reported vitamin D deficiency among patients with INDDM.<sup>18–20</sup> Although, vitamin D has a regulating role in metabolism of bone and adipose tissue.<sup>21–25</sup> This study aimed to measure relationship between serum vitamin D, adipokines and dyslipidemia in NIDDM.

The results of our study proved that secretion of leptin decreased when serum level of vitamin D is high in addition to an inverse relation between these variables. These results agreed with Amir et al.,<sup>26</sup> found a slight negative relationship between leptin and vitamin D among breast cancer women. In addition, Figueiredo-Dias & Grethen et al.,<sup>27,28</sup> proved presence of inverse relationship between serum vitamin D and leptin among patients renal insufficiency and obese women. However, supplemental vitamin D reduced level of leptin in patients with hemodialysis.<sup>29</sup> Reduced serum vitamin D may reduce the level of circulating calcium that induce hyperparathyroidism that in turn stimulates fat storage and lipogenesis and as a result enhanced adipocytes to secrete leptin.<sup>30</sup> However, our results proved that secretion of adiponectin increased when serum level of vitamin D is high in addition to a positive relation between these variables. These results agreed with Walker et al. reported that adding of vitamin D to growth medium enhanced secretion of adiponectin in mice.<sup>31</sup> However, Feng et al.,<sup>32</sup> found that vitamin D inhibited expression of TNF- $\alpha$  mRNA that is pro-inflammatory cytokine that is a main inhibitor for adiponectin synthesis. Moreover, Breslavsky et al.,<sup>33</sup> stated that one year of supplemental vitamin D enhanced adiponectin secretion.

Concerning variables of the three groups, there were significant higher mean values of TC, TG, LDL and leptin in group (III) than both group (I) and (II) as well as lower mean values of HDL and adiponectin in group (III) than group (I) and (II). However, serum level of vitamin D revealed direct correlation with HDL and adiponectin & a negative correlation with TC, TG, LDL & leptin in all groups. Our results are consistent with several studies that measured cardiovascular risk in NIDDM patients from sunny countries.<sup>34,35</sup> These findings can be justified if we considered blood lipid levels as the intervenient variable that act as a link between low vitamin D level and cardiovascular disorders in NIDDM.<sup>36–39</sup>

## Conclusion

There was relationship between vitamin D status, dyslipidemia and adipokines in noninsulin dependent diabetes mellitus.

## Acknowledgments

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## Conflict of interest

Author declares no conflict of interest.

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