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Estimation of Vitamin D and HbA1c Among Obese Type 2 Diabetic Patients

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ABSTRACT

Diabetes is a metabolic disorder that can affect nearly all organ systems in the body. Recently, Vitamin D3 was given some importance worldwide in the pathogenesis of diabetes. Deficiency in vitamin D3 appears to be linked to the development of type II diabetes and metabolic syndrome. To estimate the serum levels of Vitamin D and HbA1c among obese type II diabetic patients., and to find out the relationship between BMI with serum levels of Vitamin D and HbA1c among study participants. A cross-sectional study design for a period extended from 25th December 2021 to 10th February 2022, a total of 40 obese type II diabetes patients was selected from Al-Wafa Medical Center by non-probability sampling at Mosul city in Northern Iraq. The estimation of vitamin D and HbA1c was done by using CL900i and BS230Mindray. Statistical Package for Social Sciences (SPSS) version 26 was used for statistical data analysis. Obese type II diabetes patients exhibited a highly significant decrease (at P-value < 0.001) in the serum level of vitamin D ($t = 17.852$) with a mean (12.2180 ± 4.32852). A positive correlation ($r = 0.899$) between HbA1c level and BMI, and an inverse correlation ($r = -0.867$) between vitamin D and body mass index (BMI) at P-value < 0.001. Low vitamin D levels and elevated HbA1c are common in obese type II diabetic patients. A positive correlation between HbA1C and body mass index (BMI) and vitamin D inversely correlate with body mass index (BMI).

1. INTRODUCTION

Diabetes mellitus is a cluster of metabolic illnesses distinguished by a persistently elevated blood sugar level [1]. The most common type of diabetes mellitus is type II diabetes, and it is characterized by insulin resistance, This could be accompanied by a decrease in insulin secretion, type II diabetes symptoms include frequent urination, increased thirst, and decreased appetite, and if not managed, diabetes can result in several medical issues [2]. Diabetes has become more common in low- and middle-income nations than in high-income countries, from 108 million in 1980 to 422 million in 2014 [3].

In 2019, diabetes was the ninth greatest reason of death, with an estimated 1.5 million deaths directly related to the disease, based on available data from international research, the International Diabetes Federation (IDF) estimates that the global population of people with diabetes (aged 18–99 years) will reach 693 million by

2045 [4]. Obesity and diabetes mellitus have a complicated relationship; there is a strong link between obesity and type II diabetes; Obesity is the main risk factor for type II diabetes; it is also a precursor to type II diabetes with insulin resistance; the quantity of insulin generated in the body in obese persons with type II diabetes may be normal, but it may not be enough to fulfil the body's demands [5]. Insulin sensitivity varies throughout one's life, the most important determinant in the development of metabolic disorders is obesity, the production of a neuroendocrine hormone (NEFA), and changes in body fat distribution are two variables that influence insulin sensitivity [6]. The release of fatty acids (NEFAs) in the circulation is the most important factor determining insulin sensitivity, increased NEFA levels have been linked to insulin resistance in people with type II diabetes and obesity [7]. Regardless of the degree of weight increase, insulin resistance is linked to BMI. Body fat distribution is another major factor that influences insulin sensitivity. Insulin sensitivity was higher in people with a more peripheral fat distribution than in people with a more central fat distribution (i.e., in the abdomen and chest area) [8]. Despite their vulnerability, β-cells play an important function in controlling insulin secretion., the amount of insulin released by β-cells varies and changes depending on the stimulus's quantity, type, and route of administration, as a result, β-cells play a critical role in ensuring that blood glucose concentrations in healthy persons remain steady within a physiologically reasonable range, insulin sensitivity, as well as regulation of β-cell function, declines with fat [9]. Insulin-resistant people, thin or overweight, have higher insulin responses and poorer hepatic insulin clearance than insulin-sensitive people, deregulation of glucose levels and the development of DM occur when this mechanism fails, abnormal glucose tolerance or fasting glucose can arise when pancreatic β-cells are compromised [10]. One of the primary causes of type II diabetes is a continual reduction in the action of the pancreatic hormone insulin, according to research, when a person's insulin production is insufficient, fasting and postprandial blood glucose levels rise, glucotoxic effects on the pancreas will worsen the condition if blood glucose levels continue to rise [11]. Over time, a pre-existing genetic defect in insulin secretion, and a resulting continual rise in blood glucose levels, β-cell failure occurs [12]. Insulin resistance is one of the main causes of T2DM, and earlier research has found an inverse relationship between vitamin D and insulin resistance, suggesting that vitamin D deficiency could be a risk factor for incident T2DM [13]. Obesity, age, and a sedentary lifestyle are all risk factors for both vitamin D deficiency and T2DM. Some research has found a direct link between 25-hydroxyvitamin D levels and insulin release in pancreatic beta cells, and others have shown that vitamin D has anti-inflammatory properties [14].

2. Study Objectives

1. To estimate the serum levels of Vitamin D and HbA1c among obese type II diabetic patients.
2. To find out the relationship between serum level of Vitamin D and HbA1c with body mass index (BMI).

3. Method and material

A cross-sectional study design for a period extended from 25th December 2021 to 10th February 2022, a total of 40 obese type 2 diabetes patients were selected according to the inclusion and exclusion criteria from Al-Wafa Medical Center by non-probability sampling at Mosul city in Northern of Iraq. Inclusion criteria are as follows: Male and female obese patients diagnosed with type 2 diabetes; participants consent; male age between more than 25 years old; female age between (25-54). The exclusion criteria are underweight, normal weight; overweight patients diagnosed with type 2 diabetes; males aged less than 25 years old; females aged less than 25 years and more than 55 and obese type 2 diabetes patients taking insulin therapy. The study was approved by the College of the Nursing / University of Mosul then formal approval from the Ethical Research Committee in Nineveh Health Directorate. informed consent was taken from the participants before data collection. Data was collected through constructed interviewing questionnaire, and it is composed of (2) parts and included the following:

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Part One: Demographical characteristics of the study participants include (Age, Gender, Educational level, Occupation, Residence, Smoking, Period since diagnosis of D.M); Nutritional Assessment Chart (Weight, Height, BMI).

Part Two: This part includes laboratory tests for the research sample, including: (Serum Vit. D level, HbA1c).

3.1 Blood sampling

A blood sample from each participant in the study was drawn from the antecubital vein after sterilization by venipuncture using a 5ml disposable syringe, the blood was placed in a standard laboratory tube to estimate the serum level of HbA1c, Vitamin D). The analysis method was done using CL900i and BS230Mindray.

3.2 Statistical Analysis

The collected data were compiled and analysed using percentages, mean, median, and t-tests using SPSS version 26. P values of 0.05 were used as a cut-off point for the significance of the statistical test.

4. Results

Table 1: Demographical characteristics of obese type II diabetic variables.

Variables		Frequency	Percentage
Gender	Male	22	55.0
	Female	18	45.0
Education Level	Literacy	12	30.0
	Read & write	3	7.5
	Primary education	14	35.0
	Secondary education	6	15.0
	High education	5	12.5
Occupation	Employed	10	25.0
	Unemployed	25	62.5
	Student	1	2.5
	Retired	4	10.0
Residence	Urban	27	67.5
	Rural	13	32.5
Smoking	No	26	65.0
	Past smoker	10	25.0
	Yes	4	10.0

Table 2: Descriptive Statistics for the age, the period since diagnosis, weight, height, and body mass index (BMI) for the study group.

Variables	n	$\bar{x} \pm SD$	Min	Max
Age	40	52.05 ± 9.624	28	65
Period Since Diagnosis	40	7.88 ± 5.967	1	24
Weight	40	106.18 ± 15.480	74	140
Height	40	163.93 ± 8.135	150	180
BMI	40	42.7366 ± 5.87033	30.50	54.00

Note: $\bar{x}$: Mean; SD: Standard Deviation; n: number; Min: minimum; Max: maximum

Table 3: Descriptive Statistics and t-test for serum level of vitamin D and HbA1c among obese type II diabetes patients.

Variables	**N**	**$\bar{x} \pm SD$**	**t-test**	**P-value**

S.Vit D. Level	40	12.2180 ± 4.32852	17.852	0.000**
HbA1c	40	8.7200 ± 1.14067	48.349	0.000**

Note: ** = Significance at P. < 0.01; $\overline{x}$: Mean; SD: Standard Deviation; n: number; S.Vit D.Level: serum vitamin D level; HbA1c:Glycosylated hemoglobin.

Table 4: The correlation coefficient between the level of HbA1C with body mass index.

Variables	**BMI**		
	n	**r**	**p-value**
HbA1c	40	0.899	0.000**
Vitamin D	40	-0.867	0.000**

Note: ** = Significance at P. < 0.01;; n: number; r: correlation coefficient; HbA1c:Glycosylated hemoglobin; BMI: Body mass index.

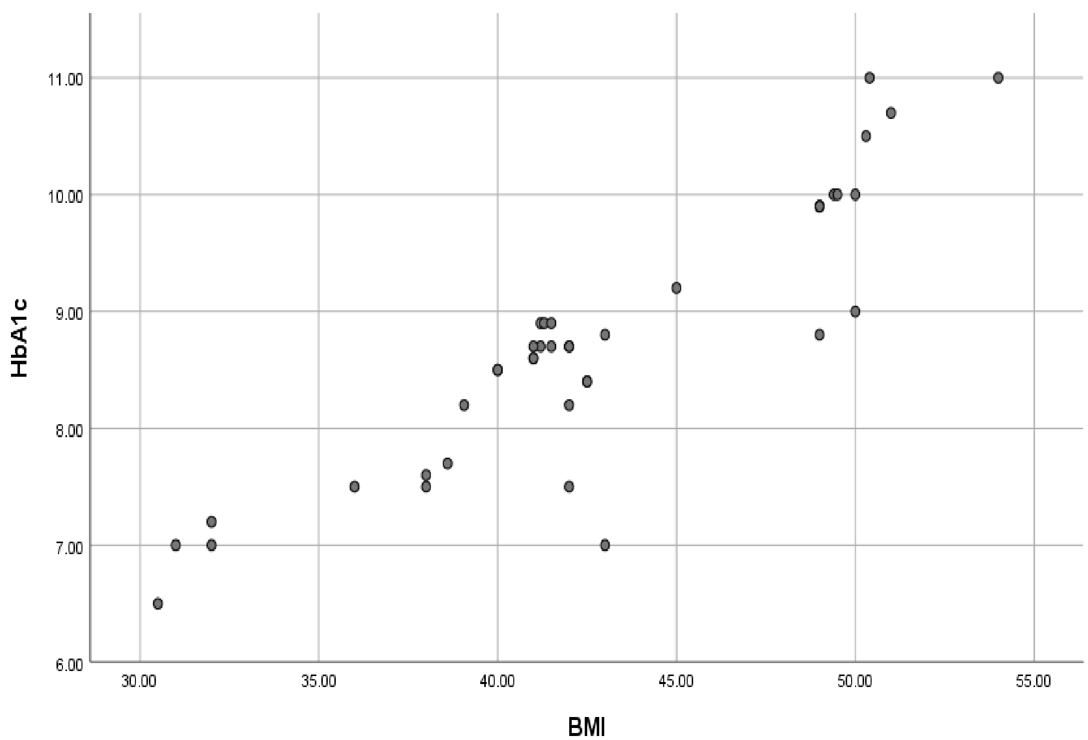

Figure 1 Scatter plot demonstrates the relationship between Glycosylated hemoglobin (HbA1c) with Body mass index BMI.

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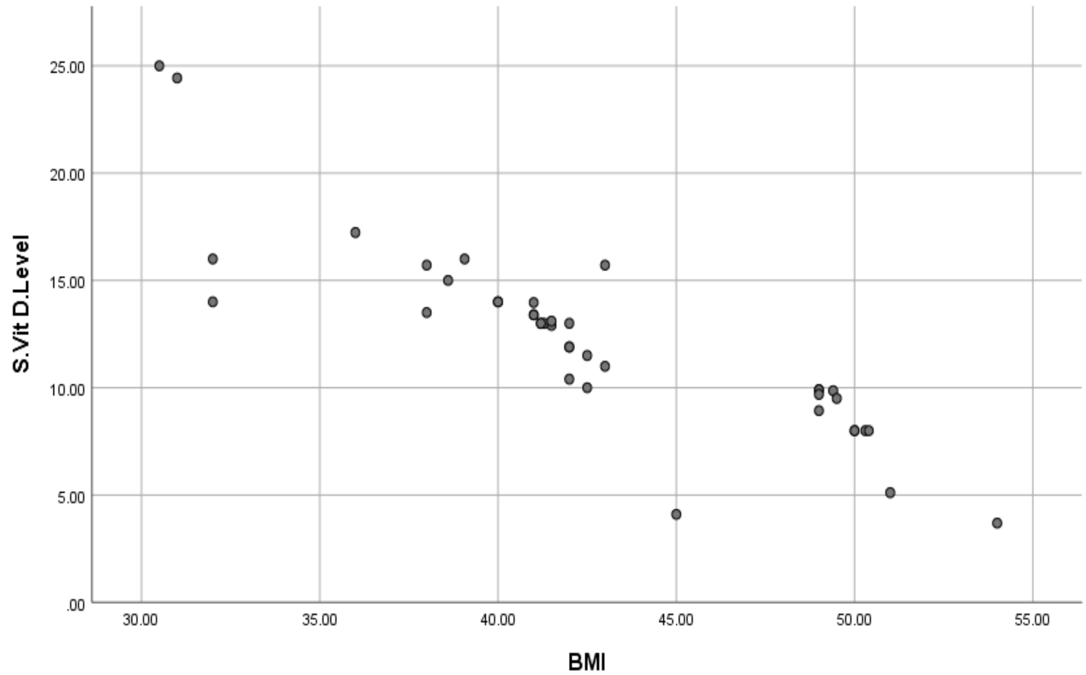

Figure 2 Scatter plot demonstrates the relationship between serum level of vitamin D with Body mass index BMI.

5. Discussion

Over the last three decades, obesity has become more prevalent around the world, along with an increase in type II diabetes and hypovitaminosis D, vitamin D deficiency has recently been linked to the development of obesity, circulating vitamin D deficiency is linked to obesity and type II diabetes, and both hypovitaminosis D and obesity are linked to prevalent disorders such as T2D [15]. Our study shows that most of the study participants were male (55%), their BMI was (42.7366 ± 5.87033), and their age of them was (52.05 ± 9.624). This finding was agreed with the results of the study conducted by [16], which reported that most of the study participants were male with BMI (40.3±5.2) kg/m2, and (55.8±7.8) years of age, this finding supports the theory of increasing BMI with aging in which contribute to a fluctuations in the body's metabolism, which can affect insulin-responsive cells and cause decreased insulin sensitivity. The findings of the study indicated that there is a statically difference in serum level of vitamin D ($\bar{x}$ ± SD= 12.2180 ± 4.32852, P < 0.001) and HbA1c ($\bar{x}$ ± SD= 8.7200 ± 1.14067, P-value < 0.001) among the study group. These results agreed with study findings conducted by [17] and [18] which reported statically differences in serum levels of vitamin D ($\bar{x}$ ± SD= 15.39 ± 4.78, P-value < 0.001), and HbA1c ($\bar{x}$ ± SD= 7.65±1.78, P-value < 0.009). Obese patients with type II diabetes are more likely to be vitamin D deficient, several factors are known to play a role in the increased risk of insufficiency, less sun exposure could be one factor, furthermore, because vitamin D is fat-soluble, those with more body fat will sequester it in fat cells, resulting in lower levels circulating in the blood. Obese type II diabetic patients can create some insulin on their own, but it's generally inadequate, or the cells in their bodies don't respond to it, and insulin resistance causes glucose (blood sugar) to accumulate in the body, resulting in an increased HbA1c. The results of this study demonstrated a positive correlation between HbA1C with BMI (r =0.899, P-value < 0.000).

This finding was agreed with the result of the study conducted by [17], which reported a positive correlation between HbA1c with BMI (r =0.439, P-value < 0.001). An elevated level of fatty acid and inflammation in obese people causes insulin resistance, which contributes to type II diabetes, obese patients with type II diabetes can create some insulin on their own, but it's generally inadequate, or the body cells don't respond to it, causing glucose (blood sugar) to accumulated in the body, resulting in an elevated HbA1c. Vice versa, Vitamin D negatively correlates with BMI (r = -0.867, P-value < 0.001). A similar study conducted in Iraq by [19], reported an inverse correlation between Vitamin D and BMI (at P-value < 0.002). Because of its lipophilic properties, vitamin D released from sun exposure and stored in subcutaneous fat is less effective in people with excess body fat, and vitamin D-mediated modulation of adipogenesis, insulin secretion, insulin sensitivity, and the immune system are the main reasons for the close relationship between obesity, glucose homeostasis, and hypovitaminosis D.

6. Conclusions

Low vitamin D levels and elevated HbA1c are common in obese patients with type II diabetes, adding to that there was a positive relationship between HbA1C and body mass index (BMI).

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