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Body mass index and glucose level among type 2 diabetic patients

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***Abstract*---**Background and Aim: Diabetes is a metabolic disorder that can affect nearly all organ systems in the body. Obesity and insulin resistance are risk factors for type II diabetes; while the amount of insulin the body produces in obese people is normal, it may not be enough to meet the body's needs. The study aimed to compare glycosylated hemoglobin among obese and non-obese diabetic patients. Method and Material: A case-control study design was conducted on (80) type II diabetic patients who attended Al-Wafaa Specialized Centre for Diabetes and Endocrinology by purposive sampling at Mosul city in Northern Iraq for a period extended from 25th December 2021 to 10th February 2022. The estimation of HbA1c was done by using BS230 Mindray. Results: Patients with type II diabetes who are obese exhibit a considerable rise in HbA1c levels, with a mean of (9.50 ± 1.90) compared to (8.10 ± 1.90) in non-obese type II diabetic patients at P-value = 0.002 (t-test =3.191). Conclusions: The HbA1c levels are higher in obese type II diabetes patients than in non-obese diabetic patients. Additionally, the majority of obese diabetes patients had poor glucose control, in contrast to the majority of non-obese diabetic patients who had good glucose control.

***Keywords*---**Type 2 Diabetes, HbA1c, Body Mass Index

1. Introduction

Diabetes mellitus: This is the term used to refer to a variety of metabolic conditions whose primary symptom is persistent hyperglycemia, either altered insulin action or a disturbed insulin release or typically both, is the cause [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[2-4]. From 108 million cases in 1980 to 422 million cases in 2014, diabetes has become more prevalent in low- and middle-income countries than in high-income ones [5]. According to data from available international research, diabetes was the ninth leading cause of death in 2019 with an estimated 1.5 million deaths directly related to the condition, the International Diabetes Federation (IDF) projects that by 2045, there will be 693 million people worldwide with diabetes (aged 18 to 99) [6]. Increased release of free fatty acids (FFAs) and adipokine dysregulation are two inflammatory mechanisms by which this adipose tissue induces insulin resistance, the majority of patients with type II diabetes are obese or have a high proportion of body fat, which is mostly concentrated in the abdominal area [7]. Obesity is a complex disease characterized by an excess of body fat; growing prevalence makes it a critical public health concern; it is linked to comorbid conditions including type II diabetes, depression, chronic renal disease, coronary artery disease, stroke, and other illnesses, all of which have a considerable economic effect [8]. The anabolic hormone insulin helps the body store energy and encourages the production of fat, it is created by beta cells in the islets of Langerhans of the pancreas and interacts with specific cell receptors in cells that are sensitive to insulin, increasing glucose absorption [9]. Insulin resistance and β–cells dysfunction are two characteristics of type II diabetes mellitus, initially, the normal range of glucose levels is maintained by a compensatory increase in the production of insulin; but, as the illness advances, beta cells change, and secretion of insulin can't keep glucose levels in the normal range, resulting in hyperglycemia [10]. Insulin resistance occurs when the cells in the muscles, fat, and liver do not respond to insulin and are unable to utilize glucose from the blood for energy, to compensate, the pancreas produces more insulin, causing the blood sugar levels to rise over time, and blood sugar levels will grow until getting prediabetes unless modifying the way of eating and exercising [11]. Insulin resistance rises in line with BMI, causing the body's blood glucose levels to rise, BMI increases when blood glucose levels rise, this causes a rise in lipid synthesis and, as a result, body weight [12-14].

2. Method and material:

Participants and study design

A case-control study design for a period extended from 25th December 2021 to 10th February 2022, a total of 40 obese and 40 non-obese type II diabetes patients were selected according to the inclusion and exclusion criteria from the Al-Wafaa Specialized Centre for Diabetes and Endocrinology by non-probability sampling at Mosul city in the north of Iraq. Inclusion criteria are as follows: Male and female obese and non-obese patients diagnosed with type II diabetes. The exclusion criteria are underweight, overweight patients diagnosed with type II diabetes.

Ethical consideration

The study was approved by the College of the Nursing / University of Mosul then formal approval from the Ethical Research Committee in the Nineveh Health Directorate. Before data collection, participants' informed consent was obtained.

Study Tools

Data was collected through a developed interviewing questionnaire, and it is composed of (2) parts and included the following:
Part One: Demographical characteristics of the study participants include (Age, Gender, Educational level, Occupation, Residence, Smoking, Period since diagnosis of D.M, Weight, Height, and BMI).
Part Two: Lab results

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. The analysis method was done using BS230Mindray.

Statistical Analysis

Using SPSS version 26, the data was compiled and analyzed using percentages, the mean, the median, and t-tests. A cutoff of P values of 0.05 was used to figure out how important the statistical test was.

3. Results

Table 1: Sociodemographic characteristics of the study group variables

Variables		Obese diabetic group (N=40)		Non-obese diabetic group (N=40)	
		F	%	F	%
Gender	Male	22	55	22	55
	Female	18	45	18	45
Educational level	Literacy	12	30.0	7	17.5
	Read & write	3	7.5	0	0
	Primary education	14	35.0	12	30.0
	Secondary education	6	15.0	13	32.5
	High education	5	12.5	8	20.0
Occupation	Employed	10	25.0	12	30.0
	Unemployed	26	65.0	24	60.0
	Retired	4	10.0	4	10.0
Residence	Urban	27	67.5	31	77.5
	Rural	13	32.5	9	22.5
Smoking	No	26	65.0	25	62.5

	Past smoker	10	25.0	4	10.0
	Yes	4	10.0	11	27.5

Note: N.: Number of Participants; F: Frequency; %: Percent.

Table 2: Standard Deviation and mean for the height, weight, age, body mass index, and the period since *diagnosis for the study group*

Variables	Obese diabetic group $\bar{x} \pm SD$ (N=40)	Non-obese diabetic group $\bar{x} \pm SD$ (N=40)	P-value
Age	52.05 ± 9.624	54.50 ± 9.682	0.260
Weight	106.18 ± 15.480	67.22 ± 7.624	0.000**
Height	163.93 ± 8.135	168.48 ± 8.524	0.017*
BMI	39.6104 ± 5.87095	23.6146 ± 1.01136	0.000**
Period Since Diagnosis	7.88 ± 5.967	8.65 ± 6.867	0.592

*Note: BMI: Body mass index; ** = Significance at P. < 0.001; $\bar{x}$: Mean; SD: Standard deviation.*

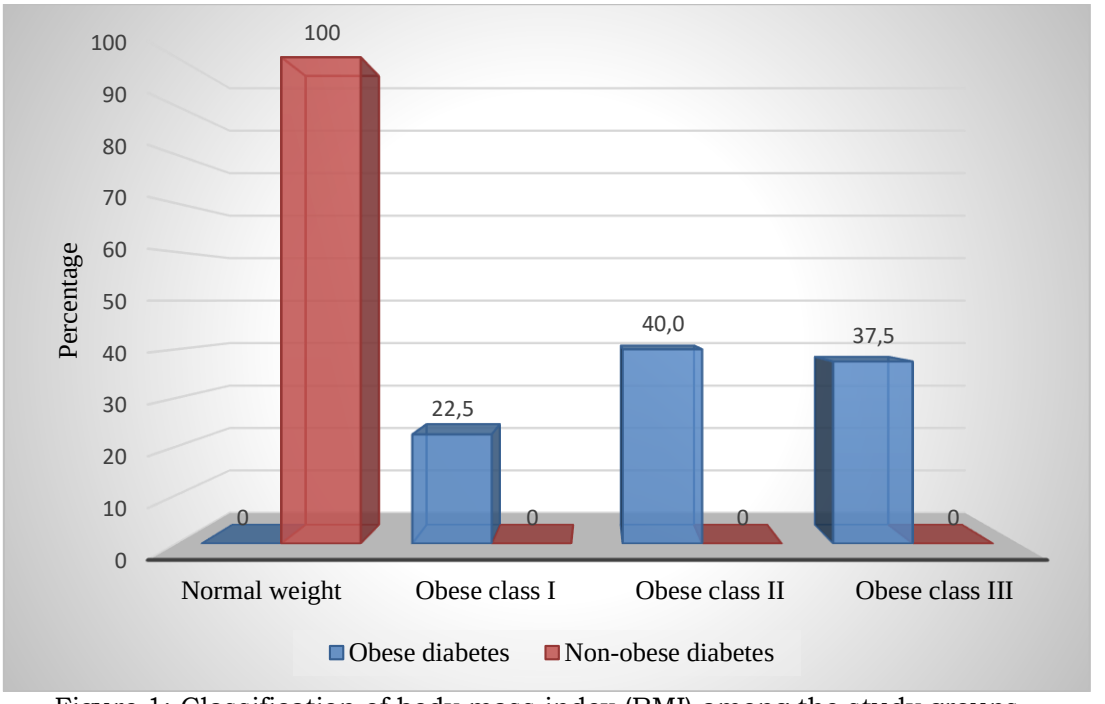

Figure 1: Classification of body mass index (BMI) among the study groups.

Table 3: Comparison of glycosylated hemoglobin levels between the groups of the study

Variable	Obese diabetic group $\bar{x}$ ± SD (N=40)	Non-obese diabetic group $\bar{x}$ ± SD (N=40)	t-test	P-value
HbA1c	9.50 ± 1.90	8.10 ± 1.90	3.191	0.002*

*Note: ** = Significance at P. < 0.001; HbA1c: glycosylated hemoglobin.*

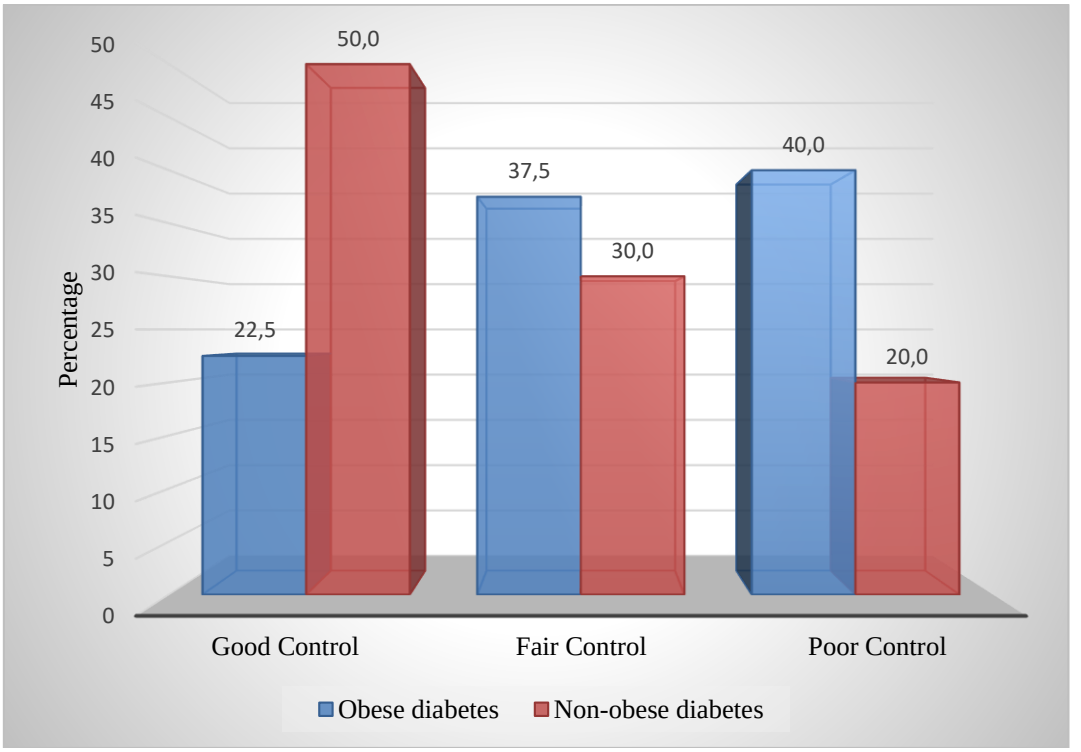

Figure 2: Classification of glucose control levels for the study groups

4. Discussion

The current study exhibited the participant's height means was (163.93 ± 8.135) cm, weight mean was (106.18 ± 15.480) kg, and concerning body mass index (BMI) most of the participants were obese class II with a mean of (39.6104 ± 5.87095) kg/m2, and the height, weight, and BMI of the obese diabetic group show differences that were significant statistically (at P. <0.05) when compared to the non-obese diabetic group, which coincided with this finding as a result of the study carried out by [15], which reported that the body mass index (BMI) most of the participants were obese with a mean of (36.4 ± 5.5) kg/m2. Obesity and diabetes mellitus have a complicated relationship, obesity is a major risk factor for type II diabetes; it is also a precursor to diabetes type II 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 fulfill the body's demands.

Our findings show a statistical difference in HbA1c level at P.= 0.002 between the obese type 2 diabetic group and the non-obese diabetic group. This finding was agreed with the result of the study conducted by [16], which reported a statistical difference in HbA1c level between study groups at P.= 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 accumulate in the body, resulting in an elevated HbA1c.

5. Conclusions

The HbA1c levels are higher in obese type II diabetes patients than in non-obese diabetic patients. Additionally, the majority of obese diabetes patients had poor glucose control, in contrast to the majority of non-obese diabetic patients who had good glucose control.

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