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Comparison of HbA1c Levels in Normal-Weight and Obese Type 2 Diabetes Mellitus Patients at Dr. Pirngadi General Hospital, Medan, North Sumatra, Indonesia

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ABSTRACT

Background: Diabetes mellitus is a collection of metabolic diseases caused by impaired insulin secretion, insulin action, or both so that it has the characteristics of hyperglycemia. Increased will cause a decrease in glucose delivery to the plasma membrane, resulting in insulin resistance in muscle and adipose tissue. This study aimed to compare HbA1c in normal weight and obese individuals with type 2 DM at Dr. Pirngadi hospital.
Subjects and Method: This was a cross-sectional study was conducted at Dr. Pirngadi Hospital, Medan, North Sumatera, Indonesia, on May 2022. A sample of 50 patients diagnosed with Type 2 Diabetes Mellitus (T2DM, HbA1c ≥6.5%). The study variables were HbA1c and body mass index (BMI). Independent t-test was used to compare HbA1c levels between normal weight and obese participants.
Results: HbA1c in type 2 DM patients with obesity (Mean= 11.49; SD= 0.60) is higher than those with normal weight (Mean= 8.71; SD= 0.34), with p= 0.002.
Conclusion: HbA1c in type 2 DM patients with obesity is higher than those with normal weight.

Keywords: HbA1c, diabetes mellitus, obesity

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BACKGROUND

Diabetes mellitus is a group of metabolic disorders characterized by impaired insulin secretion, insulin action, or both, leading to hyperglycemia. Individuals with diabetes are at an increased risk of higher morbidity and mortality due to complications such as kidney disease, blindness, leg amputation, and coronary heart disease (Hotimah & Listiawati, 2023).

The International Diabetes Federation (IDF) estimates that, in 2019, at least

463 million people worldwide aged 20-79 were living with diabetes, corresponding to a prevalence rate of 9.3% of the total population within this age group. By gender, the IDF reports a prevalence of 9% in women and 9.65% in men. The prevalence of diabetes is expected to rise with an aging population, reaching 19.9%, or approximately 111.2 million people, among those aged 65-79 years (Susanti et al., 2020).

The high prevalence of type 2 diabetes mellitus is caused by risk factors that cannot be changed, such as gender, age, and genetic factors. The second is risk factors that can be changed, such as smoking habits, educationlevel, occupation, physical activity, alcohol consumption, body mass index, waist circumference and age (Arania et al., 2021).

Type 2 Diabetes Mellitus is often referred to as the "silent killer" because it can affect multiple organs in the body and lead to a range of complications. These complications may include impaired vision, cataracts, heart disease, kidney disease, sexual dysfunction, slow-healing wounds that may become infected, lung infections, blood vessel disorders, strokes, and more. In severe cases, individuals with Type 2 Diabetes Mellitus may require limb amputations due to tissue necrosis (Zahra & Farida, 2020).

A study conducted at Wangaya Hospital in Denpasar and Sanglah in 2018 found that measuring HbA1c is an accurate method for determining average blood sugar levels over the past two to three months. Among the 30 respondents with Type 2 Diabetes Mellitus who underwent HbA1c testing, the results revealed that 40% had controlled HbA1c levels, while 60% had uncontrolled HbA1c. In the group with controlled HbA1c, 40% maintained a normal BMI, 40% adhered to recommended food intake, and 23.3% engaged in regular exercise. Furthermore, 40% consistently took antidiabetic medications. In contrast, among those with uncontrolled HbA1c, 33.3% had a normal BMI, 3.3% engaged in regular exercise, 30% followed the recommended food intake, and 40% regularly consumed antidiabetic medications. These findings suggest that respondents with controlled HbA1c levels all maintained a normal BMI and followed the recommended dietary guidelines.

Research from (Arania et al., 2021) as many as 30 samples of obesity and 30 samples without obesity, it was found that Diabetes mellitus is one of the diseases that still suffers from many people, both in the world and in Indonesia. People with diabetes reached 463 million people in 2019, representing 9.3% of the world's adult population (20-79 years). If people do not change their lifestyle, it is estimated that people with diabetes will increase to 578 million people (10.2%) in 2030, and continue to increase to 700 million people (10.9%) in 2045.2 The incidence of diabetes in Indonesia is also still low. shows an increasing trend every year. Indonesia is the 7th country with the most diabetes sufferers, namely 10.7 million people (6.2%) according to the IDFAtlas 2019. The 2018 Basic Health Research reported there were 91.

The 2019 Basic Health Research report by the Ministry of Health, shows that the prevalence of type 2 diabetes mellitus in Indonesia for ages over 15 years is 6.9%. The prevalence of diagnosed type 2 diabetes mellitus in Indonesia is 2.1%. The highest prevalence of diabetes diagnosed by doctors was in DI Yogyakarta (2.6%), DKI Jakarta (2.5%), North Sulawesi (2.4%), and East Kalimantan (2.3%). This shows that North Sulawesi is one of the provinces with the highest prevalence of type 2 diabetes mellitus in Indonesia (Bijelic et al., 2020).

In patients with type 2 diabetes mellitus with obesity, there can be an increase in fatty acids or what is called Free Fatty Acid in cells, which increases will cause a decrease in the distribution of glucose to the plasma membrane, resulting in insulin resistance in muscle and adipose tissue. Insulin resistance in body tissues and muscles causes glucosecannot be channeled into cells andaccumulates in blood vessels. This causes an increase in blood glucose levels and indicates worsening glycemic control (Khairinisa et al., 2022).

HbA1c measurement is a reliable indicator of glycemic control, reflecting blood sugar (glucose) levels over the past two to three months. An HbA1c level of 6.5% or higher is diagnostic for diabetes mellitus, while a level of 7% or above indicates a twofold increased risk of complications. Given this, regular examination and monitoring of HbA1c levels are crucial as they assist in diagnosing, managing, and predicting the prognosis of Type 2 Diabetes Mellitus (Charles et al., 2019).

A preliminary survey conducted at Dr. Pirngadi Hospital, Medan, collected data on patients with Type 2 Diabetes Mellitus (T2DM) from 2018 to 2019, revealing a total of 1,546 affected individuals. This data highlights the increasing incidence of Type 2 Diabetes Mellitus in Indonesia, signaling that it has become a significant public health issue that must be prioritized. In light of this, the researchers are interested in analyzing the relationship between HbA1c levels in Type 2 Diabetes patients, comparing those with obesity to those without obesity, at RSUD Dr. Pirngadi Medan City. The objective of this study is to explore the association between HbA1c levels in Type 2 Diabetes patients with and without obesity in Dr. Pirngadi Medan City Hospital.

SUBJECTS AND METHOD

1. Study Design

This was cross-sectional study conducted at Dr. Pirngadi general hospital in Medan, North Sumatera, Indonesia, from January 2018 to November 2019.

2. Population and Sample

The study population consisted of type 2 DM patients from the endocrine clinic of Dr. Pirngadi General Hospital. A sample of 50 type 2 DM patients (HbA1c ≥6.5%) was selected for this study. The inclusion criteria were type 2 DM patients with HbA1c ≥6.5%. Type 2 DM patients with a BMI <18.5 kg/m² or incomplete data were excluded.

3. Study Variables

The dependent variable was HbA1c. The independent variable was BMI. BMI of 30 or higher is classified as obese. Data of HbA1c were collected from the clinical pathology laboratory.

4. Operational Definition of Variables

HbA1c, also known as glycated hemoglobin, is a form of hemoglobin chemically bound to glucose. It serves as a reliable biomarker for assessing the average plasma glucose concentration over a prolonged period, typically two to three months (Mellado-Orellana et al., 2019). In patients with Type 2 Diabetes Mellitus, regular monitoring of HbA1c levels is crucial, as it provides a comprehensive overview of long-term blood sugar control. Elevated HbA1c levels signify suboptimal glucose management and are associated with an increased risk of diabetes-related complications.

Obesity is defined as an excessive accumulation of body fat that may impair health. A BMI of 30 or higher is categorized as obesity (Widyatmoko and Santyasna, 2022).

5. Study Instruments

Data were collected from patients' medical records. The medical records were used to

obtain accurate historical data on HbA1c levels and BMI measurements.

6. Data Analysis

The independent t-test was used to compare HbA1c levels between normal-weight and obese patients with type 2 DM.

RESULTS

Table 1 shows that the majority of study participants were aged 56-65 years (48.5%). Two-thirds of the participants were female (61.8%), and 72.1% of the participants were classified as obese.

Table 1. Sample Characteristic

Characteristics	Category	Frequency	Percentage
Age	36-45 years old	8	11.8%
	46-55 years old	27	39.7%
	56-65 years old	33	48.5%
Gender	Male	26	38.2%
	Female	42	61.8%
Body Mass Index	Normoweight	19	27.9%
	Obesity	49	72.1%

Table 2. Comparison of HbA1c between normal weight and obese type 2 diabetes mellitus patients

BMI	Mean	SD	p
Normal weight	8.71	0.34	0.002
Obese	11.49	0.60	

DISCUSSION

According to researchers, excessive fat deposits in the body of obese people can lead to insulin resistance which affects blood sugar levels which causes diabetes mellitus. Being overweight, both mild and moderate, because being overweight increases the risk of degenerative diseases, where diabetes mellitus is one of the degenerative diseases.

Based on the results of the study, it is known that of the 68 respondents studied, it can be seen that the most with BMI in the obesity category are 49 people (72.1%), the rest are in the normal category, namely 19people (27.9%). Diabetes Mellitus (diabetes mellitus type 2) is a group of metabolic diseases characterized by hyperglycemia that occurs due to defects in insulin secretion, insulin action or both. Globally there were 382 million people living in the world with diabetes in 2017, and by 2035 this will increase to 592 million people with diabetes mellitus. The two main physiologic abnormalities in pre-diabetes are insulinresistance and pancreatic beta-cell dysfunction, and these changes manifest before the onset of the glucose level abnormality (Puspita Sari & Sayekti, 2023).

Obesity in adults can affect the condition of glycemic status in people with diabetes mellitus. Metabolic regulated conditions such as obesity and lifestyle factors are known to have a relationship with type 2 diabetes mellitus with characteristics of hyperglycemia. Obesity is known to be associated with an increase in the amount of adipose tissue or an unbalanced distribution condition between central and peripheral areas in certain body parts which is also associated with an increase in insulin resistance, dyslipidemia, and coronary heart disease which can increase the risk of type 2 diabetes mellitus. Hyperglycemia conditions also cause an increase in the glycation process and LDL affinity for LDL

receptors in the body (Jennefer & Gunawan, 2020).

Increased fasting blood sugar levels can be influenced by several factors such as age, body fat concentration, glucose metabolism, use of drugs, dietary methods, and lifestyle. While the increase in the value of HbA1c can be caused by several factorssuch as hemoglobin factor, glycation factor, erythrocyte destruction, and other factors (Susatyo & Saraswati, 2022).

Excessive fat deposits in the body of obese people can lead to insulin resistance which affects blood sugar levels in people with diabetes mellitus. BMI of more than or equal to 25 kg/m2 in adults with obesity causes insulin receptors on target cells throughout the body to be less sensitive and the amount to decrease so that insulin in the blood cannot be utilized which has an impact on decreasing blood sugar absorption in tissues so that blood sugar levels increase. Ilyas in Soegondo, 2007). Without weight loss and lifestyle modification, people with the metabolic syndrome are at significant risk for developing significant T2DM, underscoring the importance of obesity in this disease.

The results of this study also indicate that type 2 diabetes mellitus is more common in female patients. Brunner and Suddart also found that female patients suffer from diabetes mellitus more than men. Ferann said that this was triggered by the presence of a greater percentage of body fat deposits in women compared to men, which is one of the factors that can reduce sensitivity to insulin action in the muscles and liver. According to Walsh, fluctuations in estrogen levels can affect blood glucose levels. When levels of the hormone estrogen increase, the body can become resistant to insulin.

From the results of this study, it was found that there was a relationship between body mass index and HbA1c levels in patients with type 2 diabetes mellitus. Saputra (2020) showed that thereis a relationship between BMI and Hb-A1c level in type 2 DM patients.

The study on type 2 diabetes mellitus patients at RSUD Dr. Pirngadi Medan City revealed that the majority of patients were in the late elderly age group (56-65 years), comprising 33 individuals or 48.5% of the sample. Gender analysis indicated that most of the patients were female, with 42 women making up 61.8% of the total. When examining body mass index (BMI), 49 patients, or 72.1%, were classified as obese, while 19 patients, or 27.9%, fell into the normoweight category. There is a significant correlation between higher BMI and elevated HbA1c levels, highlighting the impact of obesity on the management and prognosis of diabetes.

AUTHOR CONTRIBUTION

The authors contributed to the study in various capacities. The lead author was responsible for designing the research, conducting the literature review, and drafting the manuscript. Co-authors assisted with data collection, statistical analysis, and interpretation of results. All authors reviewed and approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest pertaining to the research, data, or its interpretation.

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