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RELATIONSHIP OF BODY MASS INDEX WITH HbA1c MEASURES IN PATIENTS AT PRIMA MEDIKA DENPASAR HOSPITAL

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Abstract

The rising prevalence of obesity in Indonesia contributes to increased risk of metabolic diseases such as diabetes mellitus. Body Mass Index (BMI) is commonly used to assess nutritional status and may be correlated with long-term blood glucose levels measured by Hemoglobin A1c (HbA1c). This study aimed to explore the relationship between BMI and HbA1c levels in patients at Prima Medika General Hospital, Denpasar. A cross-sectional analytic observational design was employed, involving 30 purposively selected respondents. BMI was calculated from weight and height measurements, while HbA1c levels were assessed using the immunoturbidimetric method. Results showed an even distribution of respondents in the normal and overweight BMI categories (each 46.5%), while 50% had HbA1c levels >8%. However, Pearson correlation analysis indicated no statistically significant relationship between BMI and HbA1c levels (p=0.982; r=-0.004). The study concludes that BMI does not have a linear correlation with HbA1c levels. Other factors such as type and duration of therapy, disease progression, and patient adherence may play a greater role in influencing glycemic control and should be further investigated.

Keywords: Insulin resistance, Metabolic syndrome, Glycemic monitoring.

1. INTRODUCTION

The issues of both overweight and underweight remain significant public health concerns, particularly in Indonesia. According to survey results Kemenkes BKPK (2023), the prevalence of obesity among Indonesians aged over 18 years has increased from 21.8% to 23.4%. This rise reflects a high rate of overnutrition status, which impacts the increased risk of various non-communicable diseases (NCDs), such as diabetes mellitus, heart disease, hypertension, and other metabolic disorders. One of the simplest and most widely used methods to assess the nutritional status of a population is the measurement of Body Mass Index (BMI), which is obtained by dividing body weight (kg) by the square of height (m^2) (Purwaningsih, 2022).

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According to Zamzami Hasibuan & A, (2021), BMI classification is divided into underweight (<18.5 kg/m²), normal (18.5–25 kg/m²), and overweight (>25 kg/m²) categories. Individuals with a high BMI tend to experience insulin resistance, which causes an imbalance in glucose metabolism within the body. Excessive body fat accumulation can inhibit insulin function and lead to chronically elevated blood glucose levels, thereby triggering the onset of type 2 diabetes mellitus (Nasution et al., 2018). Thus, BMI not only serves as a screening tool for nutritional status but also acts as an indicator of metabolic disease risk.

One of the widely used tests to monitor long-term blood glucose levels is Hemoglobin A1c (HbA1c). This test measures glycated hemoglobin, which occurs when blood glucose irreversibly binds to hemoglobin in erythrocytes. Since the lifespan of red blood cells ranges from 90 to 120 days, the HbA1c level reflects the average blood glucose over the past 2–3 (Amran & Rahman, 2018)). HbA1c is an important parameter in evaluating diabetes mellitus control and has been recommended by the American Diabetes Association (2015) as one of the diagnostic criteria for diabetes mellitus with a threshold of ≥6.5%.

The HbA1c test has several advantages compared to random or fasting blood glucose tests. This test does not require fasting, is not affected by daily glucose variations, and is more stable against environmental temperature during specimen transport. HbA1c is also more convenient for patients and provides a long-term picture of glycemic control (Sartika & Hestiani, 2019). Therefore, monitoring HbA1c is crucial in efforts to prevent long-term diabetes complications such as nephropathy, retinopathy, neuropathy, and cardiovascular diseases. Although many studies have explored the relationship between BMI and HbA1c levels, the results remain varied. Some studies report a positive correlation between the two, where individuals with high BMI tend to have higher HbA1c levels due to insulin resistance and metabolic dysregulation. However, other studies show no significant relationship between BMI and HbA1c. For example, Suandy et al (2022), reported that BMI was not significantly correlated with HbA1c levels in diabetes mellitus patients. These differing results may be influenced by confounding variables such as types of medication consumed, comorbid disease status, physical activity, diet, and genetic factors that were not controlled in the studies.

This study was conducted at RSU Prima Medika Denpasar, a type C hospital that serves a variety of patients with metabolic diseases, including diabetes mellitus. According to data from the hospital's laboratory information system, HbA1c testing is one of the routine examinations, with an average of three patients per day or more than 90 patients per month. The high volume of HbA1c tests indicates the importance of glycemic control among patients visiting this hospital. The aim of this study is to explore the relationship between Body Mass Index (BMI) and HbA1c levels in patients undergoing testing at RSU Prima Medika Denpasar. By understanding whether there is a relationship between nutritional status and long-term blood glucose levels, the results of this study are expected to contribute to the development of early screening approaches and the prevention of diabetes complications based on BMI measurements. This study can also serve as a basis for policy-making and patient education in weight management as part of comprehensive diabetes management.

2. RESEARCH METHOD

This study used a quantitative approach with an analytical observational cross-sectional design, aimed at determining the relationship between Body Mass Index (BMI) and HbA1c levels. The research was conducted at the Clinical Pathology Laboratory of RSU Prima Medika Denpasar during February–March 2025. The population in this study consisted of outpatient and inpatient patients who underwent HbA1c testing. The sample was selected using purposive

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sampling technique, consisting of 30 respondents based on the inclusion criteria: age ≥18 years, undergoing HbA1c testing during the study period, and willing to participate as respondents. Exclusion criteria included patients diagnosed with iron deficiency anemia, thalassemia, and those with a history of blood transfusion within the last 3 months. BMI was calculated from the results of weight and height measurements (kg/m²), while HbA1c levels were obtained from laboratory tests using the immunoturbidimetric method. Additional data such as age, gender, and patient diagnosis were obtained from medical records. Examination and data collection were conducted according to standard laboratory procedures. Data analysis was performed using SPSS version 25. This study received approval from the Health Research Ethics Committee of STIKES Wira Medika Bali, as evidenced by the ethical clearance letter number 418/E1.STIKESWIKA/EC/III/2025. All respondents provided written consent through informed consent forms, and data confidentiality was fully maintained for academic purposes.

3. RESULTS AND DISCUSSION

The results of this study are divided into two main sections: the measurement of Body Mass Index (BMI) and HbA1c levels, as well as the analysis of the relationship between these two variables. The researchers also conducted a characterization of the respondents as follows:

Table 1.
Respondent Characteristics Based on Gender

Gender	Number Persons	(%)
Male	17	57
Female	13	43
Total	30	100

The characteristics of the respondents in this study indicate that out of the 30 patients examined, the majority were male (57%) and aged between 46 and 65 years (53%). In terms of gender distribution, this shows that males underwent HbA1c testing more frequently than females during the study period. This pattern may be influenced by various factors, one of which is health awareness or the tendency to seek healthcare services among males in the productive age group.

However, these results contradict several previous studies, such as the one conducted by Nadifah et al (2023), where females were more dominant in undergoing HbA1c testing. This discrepancy may be due to differences in the location and characteristics of the study populations. According to research by Sihombing & Margareta (2019), females have a higher risk of developing diabetes mellitus due to hormonal fluctuations, especially during pregnancy, menopause, and menstruation, which can affect glucose and insulin metabolism. Regarding age, the 46–65 years age group was the most commonly found among the respondents. This age range falls within the late adulthood phase, which is vulnerable to various metabolic diseases, including diabetes mellitus. As age increases, insulin sensitivity tends to decrease, and insulin resistance increases, making blood glucose more difficult to control (Komariah & Rahayu, 2020). This is consistent with the report from the International Diabetes Federation (2025), which states that the prevalence of diabetes significantly increases in the age group above 45 years.

Table 2.
Respondent Characteristics Based on Age

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Age (Years)	Number (Person)	(%)
12 – 25	1	3
26 – 45	5	17
46 – 65	16	53
> 65	8	27
Total	30	100

The results of the study indicate that the majority of respondents were in the 46–65 years age range, totaling 16 individuals (53.3%), followed by the 26–45 years group with 8 individuals (26.7%), and the ≥66 years group with 6 individuals (20%). The 46–65 years age group is considered a high-risk age for metabolic disorders, including diabetes mellitus. At this stage, insulin sensitivity tends to decrease, and visceral fat accumulation occurs, contributing to insulin resistance and increased blood glucose levels (Komariah & Rahayu, 2020).

Table 3.
Characteristics of Respondents Based on Patient Diagnosis

Diagnosis	Number (Person)	(%)
Diabetes mellitus without complications	8	27
Diabetes mellitus with complications	22	73
Total	30	100

Based on the study results, respondents who underwent HbA1c testing had varied diagnostic backgrounds. The majority of respondents were patients with type 2 diabetes mellitus, totaling 20 individuals (66.7%), followed by patients with hypertension numbering 4 individuals (13.3%), while the remaining respondents had other metabolic disorders such as dyslipidemia and obesity. The predominance of type 2 diabetes patients as the largest group is expected, considering that HbA1c is the primary parameter used to assess long-term glycemic control in diabetic patients. This also indicates that Prima Medika Denpasar Hospital has a relatively high number of visits from patients with chronic metabolic disorders, especially diabetes. Meanwhile, the presence of non-diabetic patients, such as those with hypertension and dyslipidemia, who also underwent HbA1c testing reflects efforts toward prevention and early detection of complications or pre-diabetic conditions. This is important because hypertension and dyslipidemia often coexist with insulin resistance in metabolic syndrome (Genuth et al., 2015).

Table 4
Body Mass Index (BMI) Measurement Results

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BMI Category	Number (People)	(%)
Skinny	2	7
Normal	14	46,5
Fat	14	46,5
Total	30	100

Based on the results of measuring the Body Mass Index (BMI) of 30 respondents, it is known that most respondents are in the normal and obese categories, each as many as 14 people (46.5%). Meanwhile, only 2 people (6.7%) were in the thin category. The BMI category in this study refers to the standards of the Ministry of Health of the Republic of Indonesia in 2022, where normal BMI ranges from 18.5-25.0 kg, obese more than 25.0 kg, and thin less than 18.5 kg. These results indicate that the majority of patients undergoing HbA1c testing at RSU Prima Medika Denpasar have adequate to excess nutritional status. This finding is also in line with the national Riskesdas 2023 data which recorded an increase in the prevalence of obesity in the adult population in Indonesia, from 21.8% to 23.4%. A high BMI or being in the obese category can be an early indicator of the risk of metabolic diseases, including diabetes mellitus. Therefore, although in this study no significant association was found between BMI and HbA1c levels, BMI information is still relevant as one of the screening parameters for patients' health status.

Table 5.
HbA1c Test Results

HbA1c Category	Value Range	Number (People)	(%)
Good	< 6,5	12	40
Medium	6,5 - 8	3	10
Poor	> 8	15	50
Total		30	100

Examination of HbA1c levels in 30 respondents showed quite diverse results. A total of 15 people (50%) were in the poor category (>8%), 12 people (40%) in the good category (<6.5%), and 3 people (10%) in the moderate category (6.5-8%). The high number of patients with HbA1c levels in the poor category indicates that long-term blood glucose control is still a big challenge for most patients, either due to limitations in treatment, non-compliance with therapy, or a less supportive lifestyle. This result indicates that even though patients have had laboratory tests, they do not necessarily have adequate knowledge or access to effective diabetes management. This is in line with the findings of Adriani et al., 2023) which state that education level, medication adherence, physical activity, and diet are important determinants in the successful control of HbA1c levels.

Compared to other studies such as that conducted by Kadek et al (2024), where patients' HbA1c levels tend to be more controlled, this suggests that local conditions at RSU Prima Medika may require further interventions, such as patient education and a multidisciplinary approach to diabetes management. This study aims to evaluate the relationship between Body Mass Index (BMI) and HbA1c levels in patients undergoing treatment at RSU Prima Medika Denpasar. Based on the results of statistical analysis with the Pearson correlation test, it was

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found that there was no statistically significant relationship between BMI and HbA1c levels in this study sample (p value = 0.982; r value = -0.004). The p value far exceeds the general significance threshold ($p < 0.05$) indicating that variations in BMI among respondents do not have a linear correlation with changes in HbA1c levels. Meanwhile, a correlation coefficient (r) that is very close to zero and negative reflects a very weak relationship and is not statistically meaningful, so the direction of the correlation cannot be interpreted further.

This finding is in line with several previous studies. A study conducted by Suandy et al (2022) reported no significant correlation between BMI and HbA1c levels. Similarly, a study by Purwaningsih (2022) also concluded that there was no correlation between the two variables. Purwaningsih (2022) further explained that elevated glucose levels, reflected in HbA1c, may be influenced by other factors beyond BMI, such as the activity of hormones secreted by the adrenal glands, namely adrenaline (which can trigger an increase in blood glucose) and corticosteroid hormones (which can lower blood glucose). In addition, in patients with diabetes mellitus, the use of certain medications such as the sulfonylurea group can cause damage to pancreatic beta cells due to their continuous stimulation to produce insulin, potentially resulting in weight loss even though caloric intake is not reduced, thus obscuring the direct relationship between actual BMI and HbA1c levels.

However, the results of this study contrasted with a study conducted by Nasution et al (2018), which suggested an association between obesity (as one of the IMT categories) and the incidence of diabetes mellitus, which is also indirectly related to glycemic control measured through HbA1c. It should be noted that the study likely focused on the specific BMI category of fat or obesity, while this study involved a broader spectrum of BMI, namely lean, normal and obese. In this study, of the 14 respondents who fell into the obese BMI category, 8 respondents (57%) showed poor HbA1c results, while 6 respondents (43%) had good results. This observation, although not resulting in an overall significant correlation, still indicates that obesity as an important risk factor may contribute to poorly controlled HbA1c levels in certain subgroups. Obesity is known to cause excess fat in the body which can interfere with the process of insulin absorption (insulin resistance).

The lack of an overall significant association in this study could be due to several factors. First, the study sample was heterogeneous, consisting of patients with various diagnoses, such as diabetes mellitus (DM) with and without complications, including heart disease, kidney disease, hypertension, and neurological disorders. Additionally, possible variations in disease duration and type of therapy were not specifically controlled for in this correlation analysis. These factors may affect HbA1c levels independently. Second, normal BMI in diabetics does not necessarily reflect optimal metabolic conditions because it can be affected by weight loss due to uncontrolled disease or medication side effects. Third, although the sample size of 30 respondents meets the minimum requirements for correlation studies according to some literature, it may lack statistical power to detect weak or modified relationships. The factors affecting HbA1c levels are complex and not limited to BMI alone. Medication adherence, diet, physical activity, stress, and other comorbid conditions also play an important role. This study is also limited by the device used, the Alere Afinion AS100, which provides HbA1c results ranging from 4% to 15% and sample hemoglobin levels ranging from 6 g/dL to 20 g/dL. The HbA1c measurement results in this study, however, were within the device's working range (minimum 5.0%, maximum 14.5%).

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4. CONCLUSION

Based on the results of the study, it can be concluded that there is no significant relationship between body mass index (BMI) and hemoglobin A1c (HbA1c) levels (p = 0.982). The correlation between the two is very weak. Most of the respondents were men (57%) between 46 and 65 years old (53%). Most patients who had their HbA1c levels checked had diabetes mellitus with complications (73%). The BMI categories of the respondents were mostly obese and normal, with 46.5% in each category. Overall, respondents' average HbA1c levels were in the moderate category, with a mean value of 7.7% (SD = 2.2), ranging from 5.0% to 14.5%.

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