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Research Article

Association between Body Mass Index and Glycemic Status (Fasting and Postprandial) among Prolanis Participants in Primary Health Care Center

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ABSTRACT

Obesity and abnormal body mass index (BMI) are established risk factors for type 2 diabetes mellitus. However, the association between BMI and glycemic status may vary across clinical populations, particularly among individuals enrolled in chronic disease management programs. This study aimed to assess the association between BMI category and glycemic status, measured by fasting plasma glucose (FPG) and 2-hour postprandial plasma glucose (2-h PPG), among Prolanis participants at Pasar Rebo Primary Health Center. An analytical cross-sectional study was conducted using secondary medical record data from a single predefined assessment month. Participants with complete records of sex, body weight, height, FPG, and 2-h PPG were included. BMI was classified according to the WHO Asia-Pacific criteria for descriptive analysis and collapsed into underweight, normoweight, and overweight–obese groups for inferential analysis. Glycemic status was classified into normal, prediabetic range, and diabetic range categories. The association between BMI category and glycemic status was analyzed using cross-tabulation and the Fisher–Freeman–Halton exact test. A total of 454 participants were included in the final analysis. Most participants were female (68.9%) and were classified as overweight or obese (68.5%). This study's results show that the BMI category was not significantly associated with FPG status ($p = 0.888$). Diabetic-range FPG was observed in 83.2% of the underweight–normoweight group and 83.3% of the overweight–obese group. Similarly, BMI category was not significantly associated with 2-h PPG status ($p = 0.159$). Diabetic-range 2-h PPG was found in 46.2% of the underweight–normoweight group and 55.6% of the overweight–obese group. These findings suggest that BMI category alone may have limited ability to discriminate fasting or postprandial glycemic status among Prolanis participants. Direct glycemic monitoring remains important across BMI categories in this high-risk primary care population.

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) remains a major global public health burden, with its prevalence increasing in parallel with the rising rates of overweight and obesity (Khan et al., 2020). Body mass index (BMI) has long been recognized as a key modifiable risk factor for T2DM and is widely used in clinical practice as a surrogate marker for adiposity (Wang et al., 2024). Excess adipose tissue contributes to insulin resistance, chronic low-grade inflammation, and β-cell dysfunction, thereby promoting dysglycemia and disease progression (Chait & den Hartigh, 2020). However, the relationship between BMI and components of glycemic control, particularly fasting and postprandial plasma glucose, remains incompletely understood.

Fasting plasma glucose (FPG) reflects basal hepatic glucose production and insulin sensitivity, whereas 2-hour postprandial plasma glucose (2-h PPG) represents the body's ability to handle glucose load after meals (Joshi et al., 2025). Emerging evidence suggests that these two parameters may be influenced by distinct pathophysiological mechanisms and risk factors. While obesity is strongly associated with insulin resistance and elevated fasting glucose, postprandial hyperglycemia may also be influenced by factors such as dietary patterns, physical activity, gastric emptying, and pancreatic β-cell function (Młynarska et al., 2025). Consequently, the association between BMI and glycemic status may differ between fasting and postprandial conditions.

Previous studies have reported inconsistent findings regarding the relationship between BMI and glycemic markers. Some studies have demonstrated a strong correlation between higher BMI and fasting hyperglycemia (Gifari et al., 2025; Khuon et al., 2024; Par et al., 2025), whereas others found that postprandial glucose levels were not significantly associated with BMI, particularly among individuals with normal body weight (Hossain et al., 2025; Reik et al., 2024). Additionally, a growing body of literature highlights the phenomenon of "normal-weight diabetes," where individuals with normal BMI exhibit impaired glucose tolerance or diabetes, especially in Asian populations. This underscores the need for population-specific investigations, particularly in primary health care settings where early detection and prevention strategies are implemented.

In Indonesia, the burden of T2DM continues to rise, and obesity prevalence is increasing, particularly in urban areas. A national trends analysis reported that the prevalence of obesity among Indonesian adults nearly doubled, from 19.7% in 2007 to 38.3% by 2023 (Muharram et al., 2025). The *Program Pengelolaan Penyakit Kronis* (Prolanis) in primary health centers provides a valuable framework for monitoring chronic disease risk factors and glycemic status in the community (Fadlilah et al., 2024). However, data examining the differential impact of BMI on fasting versus postprandial glycemia among Prolanis participants remains limited.

Therefore, this study aimed to assess the relationship between BMI categories and glycemic status, measured by fasting plasma glucose and 2-hour postprandial plasma glucose, among Prolanis patients at Pasar Rebo Primary Health Center. Understanding whether BMI is differentially associated with basal and postprandial glycemia may provide insights into metabolic risk stratification and inform targeted screening and prevention strategies in primary care settings.

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METHODS

Research Design

This study employed an analytical cross-sectional design to evaluate the association between body mass index (BMI) category and glycemic status among participants enrolled in the *Program Pengelolaan Penyakit Kronis* (Prolanis) at Pasar Rebo Primary Health Center. The cross-sectional approach was used to assess the relationship between BMI and glycemic status at a single defined point of observation using existing clinical record data.

Data Source and Data Collection

Secondary data were obtained from PROLANIS medical records at Pasar Rebo Primary Health Center. To preserve the cross-sectional nature of the study and avoid misclassification from averaging measurements across months, data were collected from a single predefined assessment month, namely January. For each participant, sex, body weight, height, fasting plasma glucose (FPG), and 2-hour postprandial plasma glucose (2-h PPG) recorded during the January assessment were extracted.

Data were entered and managed using Microsoft Excel 2021. Data cleaning was performed to identify incomplete records, missing values, duplicate entries, and inconsistencies. Participants with complete records of sex, body weight, height, FPG, and 2-h PPG were included in the final analysis. Records with missing data for any of the studied variables were excluded. Eligible data were then coded according to the World Health Organization Asia-Pacific criteria for body mass index and the Indonesian Society of Endocrinology (PERKENI) criteria for fasting and postprandial plasma glucose before being exported for statistical analysis.

Population and Sample

The study population consisted of all Prolanis participants registered at Pasar Rebo Primary Health Center during the study period. For the revised cross-sectional analysis, all eligible participants with complete January records were included in the analysis using a total sampling approach. Based on the final data cleaning process, 454 participants were included in the analysis.

Variable Definition and Measurement

Body mass index was calculated as body weight in kilograms divided by height in meters squared. BMI was initially classified according to the WHO Asia-Pacific criteria. Due to sparse cell counts in several BMI categories, BMI was collapsed into two clinically meaningful groups for inferential analysis: underweight–normoweight and overweight–obese. The overweight–obese group was defined using the Asia-Pacific BMI threshold for increased metabolic risk.

Glycemic status was assessed using fasting plasma glucose and 2-hour postprandial plasma glucose values. FPG and 2-h PPG were categorized as normal, prediabetic range, or diabetic range based on the criteria established by the Indonesian Society of Endocrinology (PERKENI).

Data Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 32. Descriptive statistics were used to summarize participant characteristics and the distribution of BMI and glycemic status. Categorical variables were presented as frequencies and percentages.

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The association between BMI category and glycemic status was analyzed using cross-tabulation. The chi-square test was used when statistical assumptions were met. When expected cell counts were small, the Fisher–Freeman–Halton exact test was applied. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 454 subjects were included in this study based on the inclusion and exclusion criteria. The sample characteristics are presented in Table 1.

Table 1. Demographic and Anthropometric Characteristics of the Study Population (N=454)

No	Characteristic	Category	Frequency (n)	Percentage (%)
1	Sex	Male	141	31.1
		Female	313	68.9
2	BMI Category	Underweight	7	1.5
		Normoweight	136	30.0
		Overweight	81	17.8
		Obese I	174	38.3
		Obese II	56	12.3

Table 2. Distribution of Fasting Plasma Glucose (FPG) Status Across BMI Categories (N=454)

No	BMI Category	Normal FPG n (%)	Prediabetic-range FPG n (%)	Diabetic-range FPG n (%)	Total n (%)
1	Underweight - Normoweight	2 (1.4)	22 (15.4)	119 (83.2)	143 (100.0)
2	Overweight - Obese	3 (1.0)	49 (15.8)	259 (83.3)	311 (100.0)
Total n (%)		5 (1.1)	71 (15.6)	378 (83.3)	454 (100.0)

Table 3. The Relationship between Fasting Plasma Glucose Status Across BMI Categories

No	Variable	Significance value
1	Fasting Plasma Glucose	0.888

Note: Fisher-Freeman-Halton exact test; $p < 0.05$ considered significant.

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A total of 454 participants were included in the study. The demographic and anthropometric characteristics of the study population are summarized in Table 1. The majority of participants were female (n=313, 68.9%), with males comprising 31.1% (n=141) of the sample.

Regarding BMI distribution, the largest proportion of participants was classified as grade I obesity, accounting for 174 participants (38.3%). This was followed by normoweight with 136 participants (30.0%), overweight with 81 participants (17.8%), and obese grade II with 56 participants (12.3%). Only a small proportion of participants were classified as underweight: 7 (1.5%). Overall, participants in the overweight and obese categories accounted for 311 participants (68.5%), indicating that excess body weight was common among the Prolanis participants included in this study.

For inferential analysis, BMI was collapsed into two groups: underweight–normoweight and overweight–obese. The underweight–normoweight group comprised 143 participants (31.5%), while the overweight–obese group comprised 311 participants (68.5%).

Association between BMI Category and Fasting Plasma Glucose Status

The distribution of FPG status according to BMI category is presented in Table 2. Among participants in the underweight–normoweight group, 2 (1.4%) had normal FPG, 22 (15.4%) had prediabetic-range FPG, and 119 (83.2%) had diabetic-range FPG. Among participants in the overweight–obese group, 3 (1.0%) had normal FPG, 49 (15.8%) had prediabetic-range FPG, and 259 (83.3%) had diabetic-range FPG.

Overall, diabetic-range FPG was highly prevalent in both BMI groups, with nearly identical proportions between the underweight–normoweight and overweight–obese groups. The Fisher–Freeman–Halton exact test is shown in Table 3. There is no statistically significant association between BMI category and FPG status (p = 0.888)

Association between BMI Category and 2-Hour Postprandial Plasma Glucose Status

Table 4. Distribution of 2-Hour Postprandial Plasma Glucose Status Across BMI Categories (N=454)

No	BMI Category	Normal 2-h PPG n (%)	Prediabetic-range 2-h PPG n (%)	Diabetic-range 2-h PPG n (%)	Total n (%)
1	Underweight - Normoweight	20 (14.0)	57 (39.9)	66 (46.2)	143 (100.0)
2	Overweight - Obese	39 (12.5)	99 (31.8)	173 (55.6)	311 (100.0)
Total n (%)		59 (13.0)	156 (34.4)	239 (52.6)	454 (100.0)

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Table 5. The Relationship between 2-Hour Postprandial Plasma Glucose Status Across BMI Categories

No	Variable	Significance value
1	2-Hour Postprandial Plasma Glucose	0.159

Note: Fisher-Freeman-Halton exact test; $p < 0.05$ considered significant

Although the proportion of diabetic-range 2-h PPG was higher in the overweight–obese group than in the underweight–normoweight group, this difference was not statistically significant. The Fisher–Freeman–Halton exact test is shown in Table 5. There is no significant association between BMI category and 2-h PPG status ($p = 0.159$).

DISCUSSION

This study assessed the association between BMI category and glycemic status, as measured by FPG and 2-h PPG, among Prolanis participants at the Pasar Rebo Primary Health Center. The main finding was that the BMI category was not significantly associated with either FPG status or 2-h PPG status. Diabetic-range glycemia was common across both BMI groups, suggesting that BMI alone may have limited ability to discriminate glycemic abnormalities in this chronic disease management population.

This study found no statistically significant association between body mass index (BMI) category and fasting plasma glucose (FPG) status ($p = 0.888$). This finding differs from the commonly proposed pathophysiological relationship between excess adiposity and impaired regulation of fasting glucose. Pathophysiologically, obesity increases lipolysis and the flux of free fatty acids to the liver, leading to impaired insulin action and increased hepatic glucose production (Stefan, 2020). In addition, excess adipose tissue secretes pro-inflammatory adipokines such as tumor necrosis factor-α and interleukin-6, which further exacerbate systemic insulin resistance (Ahmed et al., 2021). Obesity is also known to increase basal hepatic glucose output and impair insulin-mediated suppression of gluconeogenesis, mechanisms that are primarily evident in the fasting state (Klein et al., 2022). However, the absence of a significant association in the present study suggests that BMI category alone may not adequately discriminate fasting glycemic status among Prolanis participants.

One possible explanation for this finding is the specific clinical profile of the study population. Prolanis participants represent a chronic disease management population, many of whom may already have diabetes mellitus, hypertension, or elevated cardiometabolic risk. Therefore, glycemic abnormalities may be highly prevalent across BMI categories, reducing BMI's ability to distinguish fasting glycemic status. Although higher BMI remains biologically associated with insulin resistance and β-cell dysfunction, as reported in previous studies (Mohamed-Mohamed et al., 2025; Zhang et al., 2023), the present findings indicate that fasting dysglycemia in this Prolanis cohort was not confined to participants with overweight or obesity. This is consistent with observations in Asian populations, where metabolic dysregulation may occur at lower BMI thresholds compared to Western populations, partly due to differences in body

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composition and visceral fat distribution (Pan et al., 2020). Therefore, the lack of a significant association in this study should not be interpreted as evidence that BMI is unrelated to metabolic risk, but rather that BMI may have limited discriminatory value in a high-risk clinical population.

This study also found no statistically significant association between BMI category and 2-hour postprandial plasma glucose (2-h PPG) status ($p = 0.159$). This finding suggests that postprandial glucose regulation may be influenced by factors beyond overall adiposity as measured by BMI. Postprandial glycemia is a dynamic process involving gastrointestinal hormone secretion, insulin sensitivity in skeletal muscle, pancreatic β-cell function, and gastric emptying (Dimitriadis et al., 2021; Shibib et al., 2024). In routine clinical settings, 2-h PPG values may also be affected by dietary composition, carbohydrate load, post-meal physical activity, timing of blood sampling, medication use, and individual variation in first-phase insulin secretion. Therefore, BMI alone may be insufficient to explain postprandial glycemic status in this population.

The finding that glycemic abnormalities were observed across BMI categories also supports the concept that normal or lower BMI does not necessarily indicate the absence of metabolic risk. Previous studies have reported that individuals with normal BMI may still exhibit impaired glucose regulation, particularly in Asian populations, where increased visceral adiposity may occur despite apparently normal body weight (Stefan, 2020). However, in the present study, this observation should be interpreted cautiously. Because Prolanis is specifically designed for chronic disease management, the presence of dysglycemia among underweight or normoweight participants should not be generalized to a healthy, unselected primary care population. Rather than directly concluding "normal-weight diabetes," the present findings indicate that dysglycemia may occur across BMI categories among Prolanis participants. This is in line with the concept of "metabolically obese normal weight," but further assessment using waist circumference, waist-to-hip ratio, or body composition analysis would be needed to confirm the presence of visceral adiposity or metabolic risk not captured by BMI alone (Stefan, 2020).

This study has several limitations. The major limitation is that the participants were enrolled in the *Program Pengelolaan Penyakit Kronis* (Prolanis), which is specifically designed for chronic disease management; therefore, this study population represents a selected high-risk clinical group rather than a healthy or unselected primary care population. This inherent selection bias may explain the high prevalence of dysglycemia across BMI categories, including among participants with underweight or normoweight BMI. Consequently, the findings should not be broadly interpreted as evidence of "normal-weight diabetes" in the general population and cannot be generalized to healthy individuals or unselected primary care patients. In addition, the cross-sectional design, use of secondary medical record data, lack of standardized postprandial glucose assessment, absence of important confounders such as medication use, diabetes duration, dietary intake, physical activity, and waist circumference, and the limited ability of BMI to reflect visceral adiposity should be considered when interpreting the results.

The absence of significant associations between BMI and both FPG and 2-h PPG carries important implications for clinical practice and metabolic risk assessment. In this study population, BMI did not significantly distinguish participants with different fasting or postprandial glycemic status. Therefore,

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relying solely on BMI as a criterion for glycemic screening may be inadequate, particularly in chronic disease management settings such as Prolanis. Direct glycemic monitoring remains important regardless of BMI category. This is especially relevant because postprandial hyperglycemia may contribute to cardiovascular risk and may not be fully captured by fasting glucose assessment alone (Bajaj et al., 2026). Furthermore, the presence of dysglycemia across BMI categories cautions against using BMI as the sole indicator for initiating or prioritizing glucose monitoring. These findings carry several important clinical implications. Firstly, although maintaining an optimal BMI remains an important public health and diabetes prevention strategy, the present study suggests that BMI alone should not be used to rule out dysglycemia among Prolanis participants. Lifestyle interventions targeting weight control should continue to be promoted, particularly because excess adiposity is biologically linked to insulin resistance and metabolic dysfunction. Secondly, this study highlights the complementary roles of FPG and 2-h PPG testing in primary care. Since BMI was not significantly associated with either fasting or postprandial glycemic status, direct measurement of both glycemic parameters may provide more clinically relevant information than anthropometric assessment alone. Finally, the findings underscore a key limitation of BMI as a standalone metabolic risk indicator, as it does not differentiate fat mass from muscle mass or quantify visceral fat. In clinical practice, measures such as waist circumference or waist-to-hip ratio should be considered alongside BMI, particularly in Asian populations who may develop metabolic risk at relatively lower BMI levels.

Several directions for future research emerge from this work. Longitudinal prospective studies are needed to clarify the causal relationship between changes in BMI and alterations in fasting and postprandial glycemic profiles. Further investigation is warranted into determinants of postprandial glucose independent of BMI, such as micronutrient intake, postprandial physical activity, medication use, and pancreatic beta-cell function. To better understand the role of body composition, subsequent studies should incorporate more specific parameters like body fat percentage measured via bioelectrical impedance analysis or detailed anthropometric measures of central adiposity. Additionally, exploration of genetic predispositions and inflammatory biomarkers could help explain the variation in glycemic responses observed among individuals within the same BMI category, moving toward a more personalized understanding of diabetes risk.

CONCLUSION

This study found no statistically significant association between BMI category and fasting or 2-hour postprandial plasma glucose status among Prolanis participants at Pasar Rebo Primary Health Center. Diabetic-range glycemia was frequently observed across both underweight–normoweight and overweight–obese groups, suggesting that BMI alone may be insufficient to discriminate glycemic status in this chronic disease management population.

These findings highlight the importance of direct glycemic monitoring regardless of BMI category in primary care settings, particularly among Prolanis participants who may already have elevated cardiometabolic risk. Future studies should incorporate additional metabolic risk indicators, including waist circumference, body composition, diabetes duration, medication use, dietary intake, physical activity, and other clinical confounders, to better clarify the determinants of fasting and postprandial glycemic control.

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