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The Relationship Between Anthropometric Parameters and Body Mass Index With Blood Glucose Level: An Analytical Study

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ABSTRACT

This study aims to analyze the relationship between body weight, height, body mass index (BMI), and blood glucose levels among 105 study subjects . Descriptive analysis results show that the average body weight of subjects is 64.81 kg, height is 1.62 m, and blood glucose level is 107.05 mg/dl, with significant variation in glucose levels. Scatter plots indicate that blood glucose does not have a significant relationship with body weight and height, while there is a tendency for increased blood glucose levels with increasing BMI. Correlation analysis reveals a strong positive relationship between body weight and BMI, but blood glucose does not show significant relationships with other variables. Using quantile regression, the analysis shows no significant relationship between independent variables and blood glucose at the median quantile. These findings highlight the need for further research to understand the factors influencing blood glucose levels and the importance of comprehensive assessment of anthropometric parameters.

ABSTRAK

Studi ini bertujuan untuk menganalisis hubungan antara berat badan, tinggi badan, indeks massa tubuh (IMT), dan kadar glukosa darah pada 105 subjek penelitian. Hasil analisis deskriptif menunjukkan bahwa rata-rata berat badan subjek adalah 64,81 kg, tinggi badan 1,62 m, dan kadar glukosa darah 107,05 mg/dl, dengan variasi kadar glukosa yang signifikan. Grafik sebar menunjukkan bahwa kadar glukosa darah tidak memiliki hubungan signifikan dengan berat badan dan tinggi badan, sementara terdapat kecenderungan peningkatan kadar glukosa darah seiring dengan peningkatan IMT. Analisis korelasi mengungkapkan hubungan positif yang kuat antara berat badan dan IMT, namun kadar glukosa darah tidak menunjukkan hubungan signifikan dengan variabel lainnya. Menggunakan regresi kuantil, analisis menunjukkan tidak ada hubungan signifikan antara variabel independen dan kadar glukosa darah pada kuantil median. Temuan ini menyoroti perlunya penelitian lebih lanjut untuk memahami faktor-faktor yang mempengaruhi kadar glukosa darah dan pentingnya penilaian komprehensif terhadap parameter antropometrik.

1. INTRODUCTION

Diabetes mellitus represents a significant global health challenge, with projections indicating that the number of affected individuals will reach 700 million worldwide by 2045 (Mahmudah et al., 2024). This metabolic disorder not only impacts the quality of life of individuals but also imposes a substantial economic burden on global healthcare systems (Rahmat, 2010). In recent years, the relationship between anthropometric measurements and blood glucose regulation has become a critical area of research in preventive medicine and public health. Anthropometric parameters, including body weight, height, and Body Mass Index (BMI), serve as fundamental indicators of nutritional status and

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metabolic health, providing insights into the mechanisms of glucose regulation (Damayanti, 2016; Indriakasia, 2015).

Previous studies have demonstrated correlations between anthropometric parameters and various metabolic conditions, including glucose homeostasis (Sulistianingrum, 2010). However, the specific mechanisms linking anthropometric measurements and BMI to blood glucose regulation remain incompletely understood, particularly across diverse populations. Understanding these relationships is crucial for developing effective diabetes prevention strategies and enhancing public health interventions. The significance of this research lies in its potential to identify simple, non-invasive, and cost-effective screening tools for the early detection of individuals at risk of glucose regulation disorders. Changes in body composition and anthropometric indices may precede the development of glucose dysregulation. Nevertheless, the strength and nature of these associations vary across populations and ethnic groups, underscoring the need for comprehensive investigation. Furthermore, although BMI is widely used as a surrogate measure of adiposity, its relationship with blood glucose regulation may be influenced by various factors, including age, gender, and ethnicity, warranting further exploration.

2. METHOD

This analytical observational study employed a cross-sectional design involving 105 adult participants (aged 27–80 years) selected through consecutive sampling in the Banyumas Regency area. Exclusion criteria included pregnancy, pre-existing chronic diseases, and the use of medications that influence glucose metabolism. The sample size was calculated based on a 95% confidence level, 80% statistical power, and an expected correlation coefficient.

Anthropometric measurements were performed by trained healthcare personnel using standardized protocols. Body weight was measured using a calibrated digital scale with an accuracy of 0.1 kg, with participants wearing minimal clothing and no footwear. Height was measured using a calibrated stadiometer with an accuracy of 0.1 cm, with participants positioned according to the Frankfurt plane. Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared. Blood glucose levels were assessed using fasting plasma glucose (FPG), obtained with a calibrated glucometer and validated through laboratory analysis.

Data collection procedures were standardized across all research sites. Participants were instructed to fast for 8–10 hours prior to FPG measurement, followed by a standardized glucose load for postprandial testing. Relevant demographic and clinical information was collected through structured questionnaires. Quality control measures included periodic equipment calibration and standardized training for research personnel. This study did not account for factors such as physical activity and dietary patterns, which may influence blood glucose levels. Further research should consider these factors to provide a more comprehensive understanding of blood glucose regulation.

Statistical analyses were performed using appropriate statistical software. Initial analysis included assessing data normality using the Kolmogorov-Smirnov test. Descriptive statistics were calculated for all variables, and correlations between anthropometric parameters and blood glucose levels were evaluated using Spearman's correlation coefficient. Quantile regression analysis was used to assess the independent relationships between anthropometric parameters and blood glucose levels, adjusting for potential confounding variables. Regression models included body weight, height, and BMI as independent variables, with blood glucose levels as the dependent variable. Statistical significance was set at $p<0.05$.

3. RESULT AND DISCUSSION

In this study, the results of descriptive analyses for key variables such as body weight, height, body mass index (BMI), and blood glucose levels are presented in Table 1. The average body weight of the subjects was 64.81 kg, with a median of 63.3 kg and a standard deviation (SD) of 11.35 kg, indicating considerable variability. The average height was recorded at 1.62 m, with a median of 1.61 m and an SD of 0.07 m, suggesting that the subjects exhibited relatively homogeneous height values. The BMI showed an average of 24.86, with a median of 24.34, indicating that most subjects fell within the normal weight category. The mean blood glucose level was 107.05 mg/dl, with a median of 101 mg/dl and an SD of 31.05 mg/dl, reflecting significant variability in the subjects' blood glucose profiles.

Table 1. Descriptive Statistics of Research Variables

	Mean	Median	SD	Min	Max
Body Weight (kg)	64,80781	63,3	11,34466	42	93
Height (m)	1,615143	1,61	0,072657	1,48	1,85
Body Mass Index (BMI)	24,86463	24,33594	4,19215	15,427	35,26667
Blood Glucose Level (mg/dl)	107,0476	101	31,05187	60	293

Note: SD = Standard Deviation, Min = Minimum Values, Max= Maximum Value

The results displayed in Figure 1 illustrate the relationships between blood glucose levels and body weight, height, and BMI using scatter plots. In Figure 1.A, no significant relationship was observed between blood glucose levels and body weight, with the majority of glucose levels falling below 100 mg/dl. Similarly, Figure 1.B exhibited a comparable pattern between height and blood glucose levels, where glucose levels were not consistently influenced by variations in height. Conversely, Figure 1.C revealed a slight tendency for blood glucose levels to increase with rising BMI, although this trend was inconsistent. These findings underscore the need for further evaluation to understand other factors that may influence blood glucose levels.

The Spearman correlation results are shown in Figure 2. The correlation between body weight and BMI demonstrates a strong positive relationship (r = 0.851), indicating that increases in body weight are directly proportional to BMI values. Additionally, the correlation between body weight and height shows a positive but weaker relationship (r = 0.331). Blood glucose levels exhibit a weak negative correlation with height (r = -0.060, p-value = 0.546), suggesting no significant relationship between these variables. Previous studies have also indicated that age can influence blood glucose levels, with increases in age often accompanied by elevated blood glucose levels, particularly in older individuals (Handayani et al., 2023). n this context, height may not significantly contribute to blood glucose levels, especially if age and other health conditions are not considered.

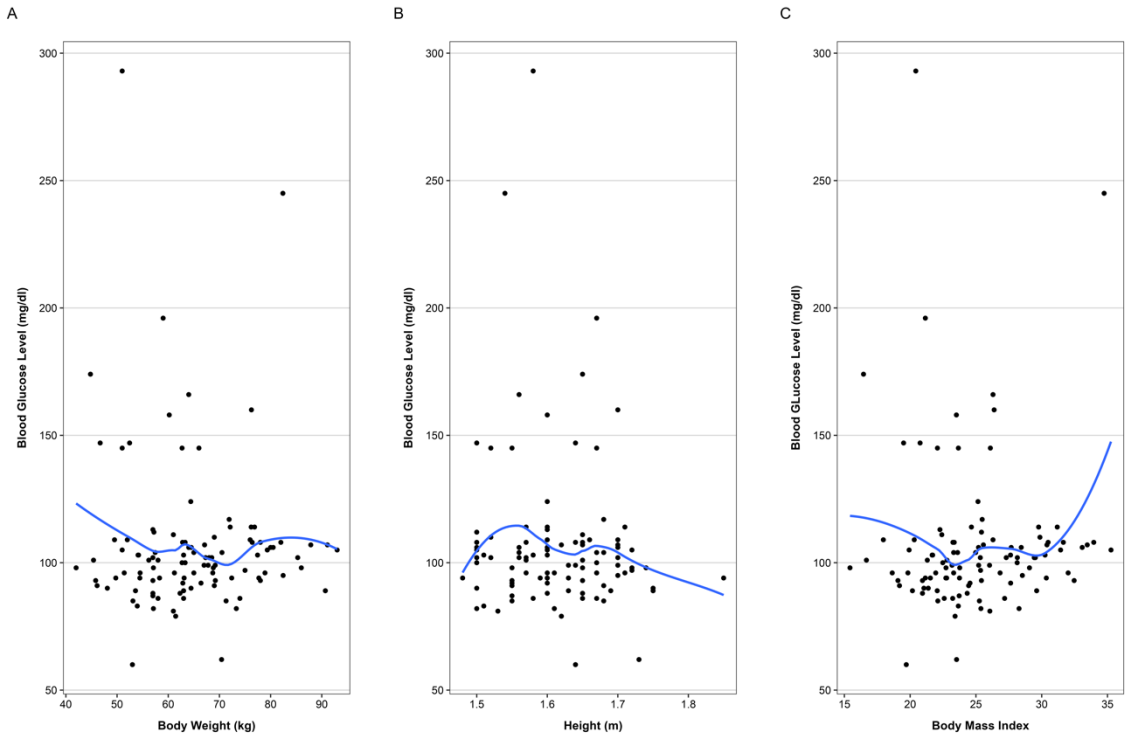

Figure 1: (A) Relationship between body weight (kg) and blood glucose levels (mg/dl), (B) Relationship between height (m) and blood glucose levels, and (C) Relationship between BMI and blood glucose levels.

Furthermore, blood glucose levels show a weak positive correlation with BMI (r = 0.144, p-value = 0.142). Although a positive relationship exists, the high p-value indicates that this correlation is not statistically significant. Other studies have shown that obesity, often measured by BMI, can contribute to the risk of diabetes mellitus (Wirastuti and Sofro, 2019). However, in certain populations, such as university students, blood glucose levels may remain normal even when BMI falls into the overweight category (Lisnawati et al., 2023). This suggests that BMI is not the sole predictor of blood glucose levels. The weak relationship between BMI and blood glucose levels is likely influenced by other factors such as genetics, lifestyle, and dietary patterns, which were not included in this study. For instance, previous research has highlighted the critical roles of physical activity and diet in glucose regulation (Noviani & Fayasari, 2018; Susanti & Bistara, 2018). Additionally, sleep quality, stress, and medication use may also contribute to variations in blood glucose levels (Sari et al., 2023). These findings have important implications for healthcare professionals. While BMI remains a useful indicator of adiposity, a multidimensional approach incorporating lifestyle factors, genetic predisposition, and metabolic markers is necessary for effective diabetes prevention. Blood glucose levels also do not show a significant relationship with body weight (r = 0.097, p-value = 0.323). Factors such as family history and diet have a greater impact on blood glucose levels than body weight (Rudi & Kwureh, 2017). This suggests that although body weight may contribute to diabetes risk, other factors such as diet and physical activity may be more determinant in blood glucose control (Nurayati & Adriani, 2017).

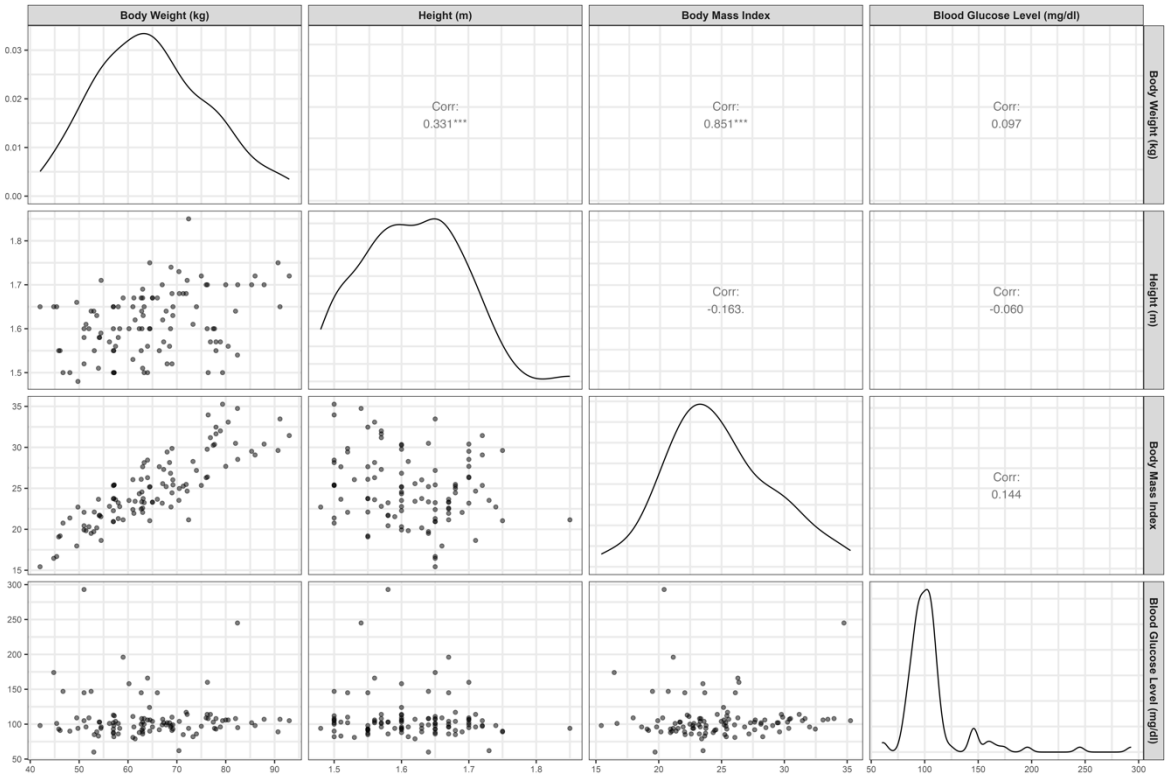

Figure 2: Correlation matrix between body weight (kg), height (m), BMI, and blood glucose levels (mg/dl).

Dietary patterns, as a variable influencing blood glucose levels, have been a focus in various studies. Susanti and Bistara emphasized the importance of proper dietary management to maintain stable blood glucose levels (Susanti and Bistara, 2018). Their research indicated that irregular eating patterns can lead to increased blood glucose levels, potentially exacerbating diabetes conditions. Moreover, regular physical activity plays a crucial role in blood glucose control. Consistent physical activity has been shown to help lower blood glucose levels in patients with type 2 diabetes (Rahayuningsih et al., 2023). Therefore, although BMI and body weight do not show significant relationships with blood glucose levels, diet and physical activity remain critical factors to consider. In this context, it is essential to recognize that blood glucose levels can be influenced by various other factors, including sleep quality, stress, and medications used by individuals (Noviani & Fayasari, 2018; Sari et al., 2023). Thus, a

multidimensional approach is required to effectively understand and manage blood glucose levels. Further research is needed to explore the relationships between blood glucose levels and other variables that may contribute to overall metabolic health.

The quantile regression analysis results indicate an intercept value of 58.37, representing the average blood glucose level when all independent variables are zero. For body weight, it was found that each unit increase is associated with a decrease in blood glucose levels of 0.29 units, although this relationship is not significant as the confidence interval includes zero. Conversely, height shows a positive effect, with each unit increase associated with a rise in blood glucose levels of 16.16 units, but again, this is not significant as the confidence interval also includes zero. Meanwhile, BMI indicates an increase in blood glucose levels of 1.38 units per unit increase in BMI, yet this effect remains non-significant. These results suggest that while patterns are observable in the data, the relationships between the analyzed variables and blood glucose levels are not strong enough to be considered significant at the median level. These findings underscore the importance of further research to explore these relationships across other quantiles and in broader contexts to provide deeper insights into the factors influencing blood glucose levels.

4. CONCLUSION

This study reveals a complex relationship between anthropometric parameters and blood glucose levels. The findings indicate that while there is no significant correlation between body weight, height, and blood glucose levels, Body Mass Index (BMI) demonstrates a tendency for increased blood glucose levels as BMI values rise, highlighting the potential risk of obesity on metabolic disorders. Furthermore, correlation matrix analyses reinforce these findings by showing that BMI has a highly significant correlation with body weight but exerts only minimal influence on blood glucose levels. Overall, this analysis underscores the importance of considering the interplay between weight, height, and BMI in the context of metabolic health. It also calls for expanded research to better understand other contributing factors that may influence blood glucose levels across broader populations.

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