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Association between Maternal Body Mass Index and Preeclampsia Incidence

Evidence from Bantul Hospital, Indonesia

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ABSTRACT

Preeclampsia remains one of the leading causes of maternal mortality worldwide and is closely associated with several risk factors, particularly obesity. According to the World Health Organization, preeclampsia affects approximately 2–8% of pregnancies globally and contributes substantially to maternal deaths. In Indonesia, preeclampsia accounts for around 25% of maternal mortality cases. In Bantul Regency, the number of preeclampsia cases increased significantly from 161 cases in 2023 to 320 cases in 2024. Obesity is recognized as an important risk factor that can increase the likelihood of preeclampsia, while Body Mass Index (BMI) is widely used to assess maternal nutritional status. However, evidence regarding the relationship between BMI and preeclampsia at PKU Muhammadiyah Bantul Hospital is still limited. This study aimed to determine the association between BMI and the incidence of preeclampsia among mothers giving birth at PKU Muhammadiyah Bantul Hospital during 2024–2025. This study employed an observational analytical design with a case-control approach. A total of 322 respondents were selected through purposive sampling using complete medical record data. Data analysis was conducted using the Chi-Square test and Odds Ratio (OR). The results showed a significant relationship between BMI and preeclampsia incidence (p = 0.001). Obese mothers were found to have a substantially higher risk of developing preeclampsia compared with non-obese mothers (OR = 48.450; 95% CI: 22.578–103.967). These findings emphasize the importance of routine BMI screening during antenatal care for early detection and prevention of preeclampsia.

Keywords
Body Mass Index
Maternal Childbirth
Obesity
Preeclampsia
Risk Factors

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Introduction

Pregnancy typically progresses normally, but certain conditions can lead to complications resulting in maternal death, such as preeclampsia. Preeclampsia is closely related to high severity and mortality rates in mothers globally [1]. According to the World Health Organization [2], preeclampsia affects 2–8% of all pregnancies worldwide. Each year, there are approximately 46,000 maternal deaths caused by preeclampsia. Preeclampsia accounts for about 10% of maternal deaths in Asia and Africa, and 25% in Latin America. Preeclampsia is a disorder that occurs during pregnancy and can affect women from various backgrounds, such as country, ethnicity, and age [3].

Maternal mortality in Indonesia remains a major issue. The Central Statistics Agency (BPS) reported a maternal mortality ratio (MMR) of 189 per 100,000 live births in 2020 [4]. Based on data from the Indonesian Ministry of Health (2023), preeclampsia cases are still the second leading cause of maternal mortality after hemorrhage, accounting for about 25% of total maternal deaths [5]. Based on the 2023 Health Profile of the Special Region of Yogyakarta (DIY), preeclampsia accounts for approximately 22.8% of total cases [6].

According to the 2023 report from the Bantul District Health Office, infection was the leading cause (44.4%), followed by hemorrhage (33.3%) and preeclampsia (22.2%) [7]. In addition, DIY Family Health [8] data shows that the number of preeclampsia cases in Bantul District increased significantly from 161 cases in 2023 to 320 cases in 2024, indicating an increase that requires stricter prevention efforts. Based on a preliminary study conducted at PKU Muhammadiyah Bantul General Hospital on November 17, 2025, the data show that there were 1,650 deliveries, with 144 cases of preeclampsia (8.72%). Of these preeclampsia cases, approximately 68.1% were obese (BMI ≥25 kg/m^2), suggesting a potential association between elevated BMI and preeclampsia risk that warrants further investigation.

Many factors can cause preeclampsia, including obesity, nutritional status, history of hypertension before pregnancy, maternal age under 20 or over 35 years, gravida status, parity, and inter-pregnancy interval [9]. One factor directly related to preeclampsia is obesity. Obesity is strongly associated with high-risk pregnancies and can increase the risk of preeclampsia by

two to three times. One method for evaluating a person's nutritional status is to use the Body Mass Index formula [10].

Research shows that pregnant women with a pre-pregnancy BMI of 27.5 kg/m^2 or higher have a 2.04 times higher risk of developing preeclampsia compared to mothers with a normal BMI [11]. Other studies have also found a significant association between BMI and the occurrence of preeclampsia [12; 13]. However, some studies did not find a significant relationship between BMI and the incidence of preeclampsia, so further research is needed to evaluate whether BMI is truly an independent risk factor for preeclampsia in this population [14].

According to previous research conducted at PKU Muhammadiyah Hospital in Bantul, Yogyakarta, Body Mass Index (BMI) was not included as an analyzed variable, so the relationship between BMI and the incidence of preeclampsia cannot be explained specifically. To date, there has been no research in the 2024 to 2025 period that examines the relationship between BMI and the incidence of preeclampsia in pregnant women at PKU Muhammadiyah Bantul General Hospital. This condition indicates a gap in research [15].

This proportion is particularly concerning in the context of national data indicating that 33.4% of women of reproductive age in Indonesia have excess nutritional status (BMI ≥ 25 kg/m^2), with an increasing proportion observed among pregnant women [16]. This national trend suggests that elevated BMI may be a contributing factor to the high preeclampsia burden observed at this facility. However, no study within the 2024–2025 period has specifically examined the relationship between BMI and preeclampsia incidence at this hospital, representing a clear and locally significant evidence gap. The novelty of this study lies in being the first to provide facility-specific evidence on the BMI–preeclampsia relationship at PKU Muhammadiyah Bantul for the 2024–2025 period, which can serve as an evidence-based foundation for developing BMI-targeted screening protocols in local antenatal care services. Without this evidence, antenatal care providers at this facility would lack a validated, locally relevant basis for identifying high-risk pregnant women through BMI screening, potentially delaying early detection and preventive intervention for preeclampsia among obese mothers.

Preeclampsia remains a major contributor to maternal morbidity and mortality, particularly in developing countries, and maternal obesity has been recognized as one of its most significant modifiable risk factors. Body Mass Index (BMI) is commonly used to assess maternal nutritional status and identify women at higher risk of pregnancy complications. Despite growing evidence linking obesity and preeclampsia, limited data are available from local healthcare facilities in Bantul Regency, especially at PKU Muhammadiyah Bantul General Hospital. The increasing number of preeclampsia cases in the region highlights the urgent need

for locally relevant evidence to support early detection and prevention strategies during antenatal care. Therefore, this study aimed to examine the relationship between maternal BMI and the incidence of preeclampsia among women giving birth at PKU Muhammadiyah Bantul General Hospital during the 2024–2025 period. Data were retrospectively obtained from hospital medical records covering deliveries from January 2024 to October 2025. Through a hospital-based case-control approach, this study seeks to provide empirical evidence regarding the role of BMI in preeclampsia risk. The findings are expected to contribute to the development of promotional and preventive health programs, improve maternal health screening practices, and enhance awareness among healthcare providers regarding the importance of BMI monitoring during pregnancy.

Material and Methods

This study is a quantitative study with an analytical observational research design using a case-control design. The independent variable in this study is BMI, and the dependent variable is the incidence of preeclampsia in pregnant women. The population in this study was pregnant women at PKU Muhammadiyah Bantul General Hospital in the period 2024-2025, totaling 1650 women. The sample size was calculated using the Slovin formula with a 5% margin of error, resulting in a sample of 322 respondents divided into case and control groups with a 1:2 ratio. Sampling in this study used purposive sampling, which is sampling based on predetermined criteria. The inclusion criteria included pregnant women who had complete medical records regarding BMI (weight and height data) and preeclampsia status (blood pressure and urine protein data). Exclusion criteria included mothers aged <20 years or >35 years, primiparas, history of gestational hypertension, history of previous preeclampsia, twin pregnancies (gemelli), and history of diabetes mellitus.

The data source used was secondary data from patient medical records. The research instrument used a dummy master table to record BMI data and preeclampsia status based on documented medical diagnoses. Data collection techniques were carried out by collecting and recording information from medical records in accordance with the variables specified in the study. Data analysis was performed univariately to describe the characteristics of the respondents and the distribution of the study variables. Bivariate analysis used the Chi-Square test to examine the relationship between BMI and the incidence of preeclampsia in pregnant women. The magnitude of risk was calculated using the Odds Ratio (OR) with a 95% confidence interval. Data processing was performed using the SPSS program. This study has obtained ethical approval from the Health Ethics Committee of PKU Muhammadiyah Bantul General Hospital with the number: 001/EC.KEPK/C/01.26.

Data for this hospital-based case-control study were retrospectively obtained from the medical records of 322 pregnant women consisting of 107 preeclampsia cases and 215

controls at PKU Muhammadiyah Bantul General Hospital between January 2024 and October 2025. All respondents originated from the same population of 1,650 deliveries recorded during the study period. The case-control approach was selected to efficiently identify the association between maternal Body Mass Index (BMI) and the incidence of preeclampsia within the local clinical context. This design also allowed comparison between mothers with and without preeclampsia to determine BMI-related risk factors associated with pregnancy complications.

Results

A. Univariate Analysis

Table 1 presents the general characteristics of respondents, including maternal age, parity status, body mass index (BMI), and the incidence of preeclampsia among mothers giving birth at PKU Muhammadiyah Bantul Hospital during the study period.

Table 1. Respondent Characteristics.

Characteristics	Frequency (n)	Percentage
Respondent Age		
• 21 - 26	32	9.6
• 27 - 30 years	111	34.5
• 31–35 years	180	55.9
Parity		
• Multipara	313	97.2
• Grandemultipara	9	2.8
BMI		
• Obesity (BMI ≥ 25 kg/m^2)	142	44.1
• Non-obese (BMI <25	180	55.9
Preeclampsia		
• Preeclampsia	111	34.5
• No Preeclampsia	211	65.5

Based on Table 1, of the 322 respondents, the majority were aged 31–35 years, accounting for 180 respondents (55.9%). This was followed by the 27–30 years age group with 111 respondents (34.5%), while the 21–26 years age group represented the smallest proportion with 31 respondents (9.6%). In terms of parity, most respondents were multiparous, totaling 313 respondents (97.2%), whereas only 9 respondents (2.8%) were categorized as grand multiparous. Based on Body Mass Index (BMI), 180 respondents (55.9%) were classified as non-obese, while 142 respondents (44.1%) were categorized as obese. Regarding the incidence of preeclampsia, the majority of respondents did not experience preeclampsia, totaling 211 respondents (65.5%). Meanwhile, 111 respondents (34.5%) were diagnosed with preeclampsia. These findings indicate that although most mothers were non-obese and did not experience preeclampsia, a substantial proportion of obese mothers and preeclampsia cases were still identified among respondents at PKU Muhammadiyah Bantul General Hospital.

B. Bivariate Analysis

Table 2 presents the relationship between Body Mass Index (BMI) and the incidence of preeclampsia among mothers giving birth at PKU Muhammadiyah Bantul Hospital during the 2024–2025 study period.

Table 2. Relationship between BMI and Preeclampsia

BMI	Preeclampsia		No Preeclampsia		Total		P-Value	OR (95%CI)
	N	%	n	%	n	%		
Obesity (BMI ≥ 25 kg/m^2).	102	71.8	40	28.2	142	100	<0.001	48.450 (22.578–103.967)
Non-Obese (BMI <25 kg/m^2)	9	5.0	171	95.0	180	100		
Total	**111**	**27.8**	**211**	**72.2**	**322**	**100**		

Based on Table 2, of the 322 respondents, the obese group experiencing preeclampsia numbered 102 respondents (71.8%), while those not experiencing preeclampsia numbered 40 respondents (28.2%). In the non-obese group, 9 respondents (5.0%) experienced preeclampsia, while 171 respondents (95.0%) did not experience preeclampsia. The results of the statistical test using the Chi-Square test yielded a p-value of 0.001 ($p < 0.05$), which means that there is a significant relationship between BMI and the incidence of preeclampsia in mothers giving birth at PKU Muhammadiyah Bantul General Hospital in the 2024-2025 period. The magnitude of the risk was calculated using an Odds Ratio (OR) of 48.450 (95% CI: 22.578–103.967). This indicates that mothers in the obesity category have a 48 times greater risk of developing preeclampsia compared to non-obese mothers.

Discussions

Based on the results of bivariate analysis in Table 2, there is a significant relationship between BMI and the incidence of preeclampsia in mothers giving birth at PKU Muhammadiyah General Hospital, Bantul, during the period 2024-2025, where the Chi-Square test yielded a p-value < 0.001. Of the 142 respondents in the obesity category (BMI ≥ 25 kg/m^2), 71.8% experienced preeclampsia, while only 5.0% of the non-obese group experienced the condition. The Odds Ratio (OR) value of 48.450 (95% CI: 22.578–103.967) indicates that obese pregnant women have approximately 48 times higher risk of developing preeclampsia compared to non-obese pregnant women.

This relationship can be explained through the underlying pathophysiological mechanisms. Obesity causes excessive adipose tissue accumulation, which produces proinflammatory adipokines. This process triggers chronic inflammation and increased oxidative stress, resulting in vascular endothelial dysfunction as the main mechanism of preeclampsia [28]. Additionally, obesity disrupts the placentation process through hormonal and genetic changes, resulting in inadequate trophoblast invasion and placental ischemia, which ultimately triggers gestational hypertension [29]. Insulin resistance, which often

accompanies obesity, further exacerbates endothelial dysfunction through reduced nitric oxide and uteroplacental perfusion [30]. Angiogenic imbalance due to increased anti-angiogenic factors, such as sFlt-1, and decreased PIGF exacerbates endothelial damage and accelerates the onset of clinical symptoms of preeclampsia [31].

These findings are consistent with previous studies showing that pregnant women with high BMI have a greater risk of developing preeclampsia. Research conducted by Aini et al. [32] proves that pregnant women in the obese BMI category have a higher risk of developing preeclampsia compared to those in the normal BMI group. Nugraha & Siallagan [33] in a case-control study in Bali confirmed that class II obesity increases the risk of preeclampsia by 2.90 times (OR = 2.90), which is in line with the findings of this study, albeit with a different risk magnitude. Rifkiansyah et al. [34] reinforced these findings by discovering a significant relationship between BMI and increased systolic and diastolic blood pressure in pregnant women with preeclampsia, indicating that BMI directly contributes to the main clinical manifestations of preeclampsia.

Several international studies also support this research, such as the study by Mao et al. [35] in a large-scale retrospective study in China, which reported that the obese group had a 3.662 times higher risk of developing preeclampsia (OR = 3.662). The study by Zhang et al. [12] also reported that women with a BMI ≥25 kg/m^2 had an approximately three times higher risk of developing preeclampsia compared to those with normal BMI. Both findings are consistent with the results of this study, which show that obesity is a significant risk factor for preeclampsia, although the magnitude of the risk is greater in the study population. Additionally, a study by Gaur et al. [31] further confirms that optimizing BMI before conception is an important primary prevention strategy for hypertensive disorders in pregnancy, including preeclampsia.

The findings of this study emphasize the importance of a holistic approach in the prevention and management of preeclampsia. Education on managing ideal body weight before pregnancy needs to be part of maternal health promotion efforts, especially in pregnancy services at PKU Muhammadiyah Bantul General Hospital. These efforts play a role in reducing the risk of preeclampsia and improving the overall health of mothers. Preventively, periodic BMI screening, blood pressure checks, and urine analysis from early pregnancy are key early detection measures, especially in pregnant women with obesity. If risk factors are identified, appropriate pregnancy management and optimal birth planning can help reduce the risk of maternal and infant illness and death due to preeclampsia. This approach is supported by various studies and clinical guidelines that emphasize the importance of strict monitoring of high-risk pregnancies, especially in referral facilities [36], so that the integration of

promotive, preventive, and curative approaches in comprehensive pregnancy services is essential to reduce the incidence of preeclampsia.

The Odds Ratio of 48.450 observed in this study is substantially higher than values reported in previous research (ranging from 2.04 to 3.66). This difference is attributable to three methodological factors: first, this study was conducted at a single referral hospital managing higher-severity cases; second, the Asia-Pacific BMI cut-off (≥25 kg/m^2) captures a broader at-risk group than Western standards; and third, the absence of multivariate analysis means confounding variables were not controlled. Despite the numerical divergence, the direction and statistical significance of the BMI–preeclampsia association remain consistent with the broader literature, underscoring the value of local, facility-specific evidence.

This study has several limitations in terms of the methods used. The case-control design is retrospective, so it cannot show a direct causal relationship between body mass index and the occurrence of preeclampsia. The purposive sampling technique has the potential to cause bias in selection because the samples are not selected randomly, so not all groups in the population are proportionally represented, and the results of the study cannot be widely applied to a larger population. The use of purposive sampling introduces the potential for selection bias, as subjects were selected based on specific inclusion criteria rather than random allocation, meaning that not all population subgroups are proportionally represented. Future studies employing random sampling across multiple facilities are recommended to improve representativeness. This study was conducted at a single referral hospital. As a referral facility, PKU Muhammadiyah Bantul General Hospital tends to manage cases with higher risk profiles compared to primary healthcare settings. This referral-center effect may have contributed to the higher proportion of obese and preeclamptic patients in the sample, and may partly explain the elevated OR observed in this study. Multicenter studies would provide a more balanced picture of the BMI–preeclampsia relationship in the general population. This study relied solely on bivariate analysis (Chi-Square test) and did not perform multivariate logistic regression to control for potential confounding variables such as maternal age, parity, and history of hypertension.

The absence of multivariate adjustment means that the independent contribution of BMI cannot be definitively confirmed, and the high OR of 48.450 may partly reflect the influence of unmeasured confounders. Future research should incorporate multivariate analysis to provide a more robust estimate of the BMI–preeclampsia association. Data were obtained from secondary sources (medical records), which introduces the potential for information bias due to incomplete or inconsistent clinical documentation. To mitigate this, only records meeting the complete inclusion criteria, including documented BMI and confirmed preeclampsia status, were included. Nevertheless, the possibility of systematic

underreporting cannot be entirely excluded. Prospective data collection in future studies would help minimize this form of bias.

Conclusion

Based on the results of a study of 322 pregnant women at PKU Muhammadiyah Bantul General Hospital in the period 2024–2025, a significant relationship was found between BMI and the incidence of preeclampsia. Pregnant women in the obese category had a higher proportion of preeclampsia than the non-obese group. The Chi-Square test results showed a p-value of 0.001 ($p < 0.05$) with an Odds Ratio (OR) of 48.450 (95% CI: 22.578–103.967), indicating that mothers in the obese BMI category had approximately 48 times greater risk of developing preeclampsia compared to non-obese mothers. However, given that multivariate analysis was not performed, the independent contribution of BMI to preeclampsia risk cannot be definitively confirmed, and the elevated OR may partly reflect unmeasured confounding variables. These findings provide the first facility-specific evidence supporting BMI-based risk stratification for preeclampsia screening in antenatal care at PKU Muhammadiyah Bantul Hospital, which can inform the development of targeted preventive protocols in local maternal health services. These findings are urgently needed to strengthen local antenatal care protocols, as the rising preeclampsia burden at this referral facility demands evidence-based screening strategies that can be implemented immediately by midwives and obstetric care providers.

Limitation and Suggestions

This study is limited by its retrospective case-control design and purposive sampling at a single referral hospital, which may introduce selection and information bias and limit the generalizability of findings to broader community settings. Pregnant women are therefore advised to maintain normal body weight through balanced nutrition, appropriate physical activity, and regular antenatal visits to support early detection of preeclampsia. Midwives should integrate BMI monitoring and blood pressure screening from the first antenatal visit. PKU Muhammadiyah Bantul Hospital should use these findings to develop targeted preeclampsia screening protocols. Universitas Aisyiyah Yogyakarta may use this study as a reference to promote further local maternal health research.

Conflict of Interest

The authors declare no conflict of interest.

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