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Analysis of Risk Factors for Mean Arterial Pressure and Body Mass Index on the Incidence of Preeclampsia

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Abstract

Preeclampsia is a major cause of maternal and perinatal morbidity and mortality worldwide, including in Indonesia. Early screening during pregnancy allows for early identification and optimal patient monitoring. This study aimed to analyze the relationship between Mean Arterial Pressure (MAP) and Body Mass Index (BMI) with the incidence of Preeclampsia, and to determine the most dominant factor in the working area of Pakjo Community Health Center (Puskesmas) Palembang. This study used a Case-Control design. The sample consisted of 62 pregnant women, divided into 31 Preeclampsia cases and 31 Non-Preeclampsia controls, derived from medical record data for the 2023–2024 period. Data analysis utilized the Chi-Square test for bivariate analysis and Binary Logistic Regression for multivariate analysis. Bivariate Analysis: A statistically significant relationship was found between Positive MAP ($p < 0.001$, OR = 6.597) and Overweight/Obese BMI ($p < 0.001$, OR = 8.381) with the incidence of Preeclampsia. Multivariate Analysis: After controlling for MAP, only High BMI proved to be a significant independent predictor ($p = 0.030$). Pregnant women with High BMI had a 4 times greater chance of experiencing Preeclampsia (OR = 4.848; 95% CI: 1.165–20.182). The MAP variable became non-significant in the multivariate model ($p = 0.234$). High BMI (Obesity/Overweight) is the most dominant risk factor and a strong independent predictor for the incidence of Preeclampsia. It is recommended that Pakjo Community Health Center prioritize intervention programs focused on weight management and nutrition counseling starting from the pre-pregnancy and early pregnancy periods as a primary effort to prevent Preeclampsia.

Introduction

Pregnancy is a natural (physiological) process experienced by women. However, problems often arise that can cause serious complications during pregnancy. These complications generally begin to emerge in the second trimester of pregnancy, around 20 weeks of gestation. One of the most frequent complications in pregnant women in the second trimester is Preeclampsia, which is characterized by an increase in high blood pressure (Suryatini et al., 2022; Wu et al., 2022; Overton et al., 2022; Hurrell et al., 2022; Mei & Ashar, 2023; Ren et al., 2023).

Preeclampsia is the most recognized medical condition in this group of diseases. This condition is also one of the frequent complications of pregnancy, with a prevalence reaching about 2 to 15% of all pregnancies (Mou et al., 2021; Chang et al., 2023).

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Preeclampsia is one of the pregnancy conditions that is the leading cause of maternal death, and its cases have shown an increasing prevalence recently (Chang et al., 2023; Shandilya et al., 2023; Khan et al., 2022; Khan et al., 2023). This condition is characterized by an increase in blood pressure, specifically systolic pressure $>140 \text{ mmHg}$ and diastolic pressure >90 mmHg. This blood pressure increase generally occurs after 20 weeks of gestation. Besides high blood pressure, preeclampsia can also be accompanied by other symptoms, such as body swelling (edema) leading to maternal weight gain, and the presence of protein in the urine (proteinuria) detected through laboratory examination. Preeclampsia can trigger various serious complications, including premature birth, fetal death during or immediately after delivery (perinatal death), and impaired fetal growth in the womb (Dimitriadis et al., 2023; Tousty et al., 2022; Koteswari et al., 2022; Hansson et al., 2022). Furthermore, in women experiencing preeclampsia, vascular vasoconstriction occurs, potentially disrupting the function of vital organs, such as the brain, kidneys, liver, and other important organs (Juwita, 2022; Conley, 2024; Chang et al., 2023; Yang et al., 2024; Schwartz & Stanhewicz, 2024).

According to 2023 World Health Organization (WHO) data, approximately 260,000 cases of maternal mortality were recorded due to complications during pregnancy, childbirth, and the puerperium. The Maternal Mortality Rate (MMR) is an important indicator for measuring the degree of women's health. About 90% of global maternal deaths occur in low- and lower-middle-income countries, with the Sub-Saharan African region having the highest maternal mortality ratio. To achieve the target of Sustainable Development Goal (SDG) 3.1, which is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030, efforts are needed to accelerate the reduction of the maternal mortality rate up to ten times faster than the current rate of decline (WHO, 2023; Solnes Miltenburg et al., 2023; Souza et al., 2024).

Hypertension during pregnancy causes 14% of all maternal deaths in both developing and developed countries. An estimated 50,000 cases of maternal death each year are caused by complications from preeclampsia. This trend is predicted to continue increasing, with an estimated 1.15 billion cases of preeclampsia worldwide by 2025, or almost 29% of the global population. In Indonesia itself, the incidence of preeclampsia reached 128,273 cases per year, which is approximately 5.35% of the total pregnancies (Ningrum, 2020; Suryatini et al., 2022).

In 2023, there was an increase in maternal death cases in Palembang City, totaling 16 cases. Preeclampsia was recorded as one of the main causes of these deaths (Dinas Kesehatan Kota Palembang, 2023).

Early symptoms of preeclampsia often found are drastic weight gain in a short period, which then triggers swelling (edema) on the face and extremities (Tamás et al., 2025; Chang et al., 2023; Susanti et al., 2023; Galego & Melhado, 2026). Therefore, it is important for pregnant women to regularly monitor weight gain during every Antenatal Care (ANC) visit, with adjustments based on Body Mass Index (BMI). In addition to monitoring BMI, blood pressure checks, including Mean Arterial Pressure (MAP) measurement, must be performed on every pregnant woman, especially once the pregnancy enters the second trimester or after 20 weeks of gestation (Lalenoh, 2018; Hurrell et al., 2022; He et al., 2025; Anya et al., 2025).

There are various ways to detect preeclampsia in pregnant women, one of which is by measuring the Body Mass Index (BMI). BMI serves as an indicator to determine whether a person's weight is considered healthy or not. If the BMI value is outside the normal limit, the risk of experiencing health problems including mild hypertension will significantly increase (Pluta et al., 2022; Mallamaci & Tripepi, 2024). The BMI value itself is obtained from calculations based on a person's height and weight. Besides BMI, Mean Arterial Pressure (MAP) is also used in the early detection of preeclampsia. MAP is calculated based on systolic and diastolic blood pressure values. The MAP result is categorized as positive (at risk of

preeclampsia) if the value is more than 90 mmHg and categorized as negative if the value is less than 85 mmHg (Sofiyanti et al., 2023).

Various studies have identified several risk factors that can trigger the occurrence of preeclampsia. Two of the main ones are Mean Arterial Pressure (MAP) and Body Mass Index (BMI). High MAP from early pregnancy has been recognized as an indicator or early predictor of the onset of gestational hypertension. Meanwhile, BMI reflects the nutritional status of the mother, both before and during pregnancy, which can affect vascular function and body metabolism (Sandstrom et al., 2019; Evsevieva et al., 2022; Lubrano et al., 2024; Mandò et al., 2025).

Efforts for early detection of these risk factors are very important, especially in primary health care facilities like community health centers (Puskesmas), as well as advanced levels such as hospitals. Research by Nankabirwa et al. (2023) emphasizes the need to utilize MAP and BMI as easily applicable predictors at various levels of health facilities. However, research simultaneously examining the relationship between these three indicators with the incidence of preeclampsia, especially with a multicenter approach in various types of health facilities, is still limited.

Methods

This study adopted a quantitative retrospective case control design to examine the association between maternal physiological indicators and the incidence of preeclampsia. The use of a case control approach is methodologically appropriate given the relatively low prevalence of preeclampsia and the need to efficiently estimate risk through odds ratios. By relying on existing clinical records from the Pakjo Community Health Center for the 2023 to 2024 period, the design allows for systematic comparison between affected and unaffected groups while minimizing time and resource constraints. However, the retrospective nature also requires careful consideration of data completeness and accuracy.

The selection of Mean Arterial Pressure and Body Mass Index as predictor variables reflects their established relevance in hypertensive disorders of pregnancy. MAP represents a more stable indicator of hemodynamic status than single blood pressure measurements, while BMI serves as a proxy for maternal nutritional and metabolic status. Focusing on these variables strengthens the biological plausibility of the study framework. Nevertheless, the exclusion of other known risk factors such as maternal age, parity, and gestational age limits the ability to fully account for potential confounding influences.

The dependent variable was the incidence of preeclampsia, defined based on clinical diagnosis during the study period. Clear operationalization of this outcome is essential to ensure consistency between case identification and control selection. The study included 31 cases and 31 controls, which ensures balanced group comparison. While this matching improves internal validity, the relatively small sample size may reduce statistical power and limit the precision of the estimated odds ratios.

The study design enables the estimation of associations rather than causal relationships. Although MAP and BMI are measured prior to or concurrent with the diagnosis of preeclampsia, the temporal sequence cannot be fully confirmed due to reliance on retrospective records. This limitation should be acknowledged when interpreting the findings, particularly when discussing clinical implications or risk prediction.

Result and Discussion

Table 1. characteristics respondents

Characteristics respondents	n	%
Age		

21-25 years old	6	9.7
26-30 years old	22	35.5
31-35 years old	19	30.6
35-40	6	9.7
>40 years	9	14.5
Parity		
nulliparous	23	37.1
primipara	18	29
multiparous	18	29
grandemultipara	3	4.8
Education		
Elementary School	2	3.2
JUNIOR HIGH SCHOOL	3	4.8
D3 High School	33	53.2
	7	25.8
S1	16	11.3
S2	1	1.6
Incident preeclampsia		
PE	31	50
No PE	31	50

Based on results analysis univariate from Table 1 it is found that majority characteristics respondents dominated by groups aged 26-30 years (as many as 22 mothers pregnant or 35.5%). From the side parity (history childbirth), the majority respondents is nullipara (not yet) Once giving birth), namely 23 mothers pregnant (37.1%). Meanwhile that , seen from level education , respondents dominated by high school graduates (33 respondents) or 53.2%). In general total , amount respondents in group preeclampsia and clusters control (no preeclampsia) distributed in a way evenly distributed , each numbering 31 people, representing 50% of the total respondents .

Frequency Distribution of Mean Arterial Pressure (MAP) in the Case Group"

Table 2. Distribution of Case Group on Preeclampsia Incidence at Pakjo Community Health Center Palembang can be seen in the table below

Variables	**n**	**%**
MAP negative	6	19.4
MAP positive	25	80.6
Total	31	100

Based on the data in Table 6.2, it was found that the majority of pregnant women respondents in the 2023–2024 period showed a positive Mean Arterial Pressure (MAP) result, which was 25 people (80.6%).

Table 3. Frequency Distribution of MAP in the Control Group

The distribution of the case group regarding the incidence of preeclampsia at Pakjo Community Health Center Palembang can be seen in Table 3.

Variabel	**n**	**%**
MAP negative	23	74.2
MAP positive	8	80.6
Total	31	100

Based on the data in Table 3, most pregnant women respondents in the 2023–2024 period showed a negative Mean Arterial Pressure (MAP) result, namely 23 people (74.2%)

Frequency Distribution of MAP in the Case and Control Groups

The frequency distribution of MAP regarding the incidence of preeclampsia at Pakjo Community Health Center Palembang in 2023–2024 can be seen in Table 4.

Table 4. Frequency Distribution of Mean Arterial Pressure (MAP)

Variabel	n	%
MAP negative	25	40.3
MAP positive	37	59.7
Total	62	100

Based on the data in Table 4, out of a total of 62 pregnant women respondents in the 2023–2024 period, it was found that the majority of respondents showed a positive Mean Arterial Pressure (MAP) result, which was 37 people or 59.7%.

Frequency Distribution of Body Mass Index (BMI)

Frequency Distribution of BMI in the Case Group

The frequency distribution of BMI in the case group regarding the incidence of preeclampsia at Pakjo Community Health Center Palembang during the 2023–2024 period can be seen in Table 5.

Table 5. Frequency Distribution of BMI in the Case Group

Variabel	n	%
Normal BMI	7	22.6
Overweight and Obese BMI	24	77.4
Total	31	100

Based on the data in Table 5, the majority of pregnant women respondents in the 2023–2024 period showed a Body Mass Index (BMI) result in the overweight and obese categories, which was 24 people or 77.4%.

Frequency Distribution of BMI in the Control Group

The frequency distribution of BMI in the control group regarding the incidence of preeclampsia at Pakjo Community Health Center Palembang during the 2023–2024 period can be seen in Table 6.

Table 6. Frequency Distribution of BMI in the Control Group

Variabel	n	%
Normal BMI	22	71
Overweight and Obese BMI	9	29
Total	31	100

Based on the data in Table 6, it was found that most pregnant women respondents in the 2023–2024 period had a Body Mass Index (BMI) result in the normal category, namely 22 people or 71%.

Frequency Distribution of BMI in the Case and Control Groups

The frequency distribution of BMI regarding the incidence of preeclampsia at Pakjo Community Health Center Palembang during the 2023–2024 period can be seen in Table 7.

Table 7. Frequency Distribution of Body Mass Index (BMI) in the Case and Control Groups

Variabel	n	%
Normal BMI	29	46.8
Overweight and Obese BMI	33	53.2

Total	62	100

Based on the data in Table 7, the majority of pregnant women respondents included in the case-control group for the 2023–2024 period showed a Body Mass Index (BMI) result in the overweight and obese categories, which was 33 people or 53.2%.

Bivariate Analysis

The Relationship between Mean Arterial Pressure (MAP) Risk Factor and Preeclampsia Incidence in the Working Area of Pakjo Community Health Center, Palembang, 2023–2024 Period

The bivariate analysis of the relationship between the Mean Arterial Pressure (MAP) risk factor and preeclampsia incidence in the working area of Pakjo Community Health Center, Palembang, during the 2023–2024 period can be seen in Table 8.

Table 8. Relationship between Mean Arterial Pressure (MAP) and Preeclampsia Incidence at Pakjo Community Health Center Palembang, 2023–2024 Period

MAP	**Preeclampsia Incidence**		***P value***	***OR (95% CI)***
	Case n (%)	**Conrol n (%)**		
MAP positive	25 (80.6)	12 (38.7)	0.010	6.597
MAP negative	6 (19.4)	19 (61.3)		
Total	**31 (100%)**	**31 (100%)**		

This study found that pregnant women with MAP screening results >90 mmHg were more numerous (80.6%), and the Chi-Square test result showed a *p-value* of 0.010. Because the *p-value* is less than 0.05, it is concluded that there is a significant relationship between the Mean Arterial Pressure (MAP) screening result and the incidence of preeclampsia. Pregnant women with a positive MAP screening result >90 mmHg have an opportunity 6.597 or 6 times greater to experience preeclampsia compared to pregnant women with negative MAP

The Relationship between Body Mass Index (BMI) Risk Factor and Preeclampsia Incidence in the Working Area of Pakjo Community Health Center, Palembang, 2023–2024 Period

The bivariate analysis of the relationship between the Body Mass Index (BMI) risk factor and preeclampsia incidence in the working area of Pakjo Community Health Center, Palembang, during the 2023–2024 period can be seen in Table 9.

Table 9. Relationship Between Body Mass Index Categories and Preeclampsia Incidence

BMI	**Preeclampsia Incidence**		***P value***	***OR (95% CI)***
	case n (%)	**conrol n (%)**		
Overweight and Obese BMI	24 (77.4)	9 (29.0)	0.01	8.381
Normal BMI	7 (22.6)	22 (71.)		
Total	**31 (100%)**	**31 (100%)**		

This study found that pregnant women with overweight and obese BMI screening results were numerous (77.4%), and the Chi-Square test result showed a *p-value* of 0.001. Because the *p-value* is less than 0.05, it is concluded that there is a significant relationship between the Body Mass Index (BMI) screening result and the incidence of preeclampsia. Pregnant women with normal BMI had an opportunity 8.381 or 8 times greater to experience preeclampsia compared to pregnant women with positive MAP screening results >90 mmHg.

The bivariate analysis shows that both independent variables, Mean Arterial Pressure (MAP) and Body Mass Index (BMI), have a statistically significant relationship with the incidence of preeclampsia, with *p-values* <0.05. The Odds Ratio (OR) test results show that overweight/obese BMI has a higher risk (OR = 8.381), indicating that pregnant women with overweight/obese BMI have an approximately 8 times greater chance of experiencing preeclampsia compared to women with normal BMI. Pregnant women with positive MAP >90 mmHg have an approximately 6 times greater chance (OR = 6.591) of experiencing preeclampsia compared to women with negative MAP

Multivariate Analysis

The multivariate analysis for this study can be seen in Table 10, as follows.:

Table 10. Association of Body Mass Index and Mean Arterial Pressure with Preeclampsia

Variabel indepanden	Category	case n=31 (%)	control n=31 (%)	OR bivariat	OR multivariat	*p-value*
Body Mass Index (BMI)	Overweight and Obese	24 (77.4%)	9 (29%)	8.381	4.848	0.030
	normal	7 (22.6%)	22 (71%)			
Mean arterial pressure (MAP)	Positive >90 mmhg	25 (80.6%)	12 (38.7%)	6.597	2.441	0.234
	Negative <90 mmhg	6 (19.4%)	19 (61.4%)			

The multivariate analysis used binary logistic regression. The results showed that overall, the formed regression model (Hosmer and Lemeshow test $p=0.106$) was capable of predicting the incidence of preeclampsia with an accuracy of 74%. After controlling for MAP, BMI remained a significant predictor ($p=0.030$) with an OR value of 4.848. The risk of preeclampsia in women with overweight/obese BMI is approximately 5 times greater.

Univariate Analysis

This study involved a total of 62 pregnant women at Pakjo Community Health Center (Puskesmas) Palembang during the 2023–2024 period, consisting of 31 preeclampsia cases and 31 pregnant women as the control group. The age distribution of respondents shows that the 26–30 years age group was the most frequent (22 pregnant women or 35.5%). This finding is supported by the research of Nurul et al. A study conducted in 2022 on the Relationship between Age and Parity with the Incidence of Preeclampsia found a significant relationship between maternal age and the risk of preeclampsia. The research results indicated that pregnant women in the high-risk age category (above 30 years) had a greater tendency to experience preeclampsia compared to women in the low-risk age category.

The research results showed that the majority of respondents had nullipara parity (never given birth), which was 23 pregnant women (37.1%). Clinically, nulliparous women have a higher risk of experiencing preeclampsia (Dinni, 2024). This is due to several mechanisms: in the first pregnancy (primigravida), the mother is exposed to chorionic villi for the first time with the risk increasing drastically if the exposure to chorionic villi occurs in excessive amounts, such as in twin or molar (hydatidiform mole) pregnancies. Additionally, in nullipara, pregnancies between the 28th and 32nd week often show an increased vascular sensitivity to vasopressor substances that trigger preeclampsia. Theoretically, nulliparous women also have a greater tendency for the risk of immunological intolerance to pregnancy (halery, 2021).

Based on the data, the majority education level of respondents was Senior High School (SMA) (33 respondents or 53.2%). This finding is relevant to the research results of Sutiati Bardja at Arjawinangun Regional General Hospital, Cirebon Regency, in 2019, which revealed a relationship between the incidence of preeclampsia and the educational history of pregnant women (Sutiati Bardja, 2020). This knowledge is very important for pregnant women because a good understanding of pregnancy and its complications allows them to recognize, detect, and address symptoms and indicators of health problems.

Bivariate Analysis

Relationship between Mean Arterial Pressure (MAP) and Preeclampsia Incidence at Pakjo Community Health Center Palembang, 2023–2024 Period

Based on the Chi-Square test results, a significant relationship was found between MAP >90 mmHg and the incidence of Preeclampsia ($p < 0.001$). Pregnant women with positive MAP had a 6.597 times greater chance of experiencing Preeclampsia. These findings support the role of MAP as a critical clinical indicator, where high MAP in early or mid-pregnancy is often used as an effective screening tool, as high blood pressure reflects increased systemic vascular resistance.

The findings of this study reinforce the results of Aisyah et al.'s study (2024), which showed a significant correlation between Mean Arterial Pressure (MAP) measurement and the incidence of preeclampsia at PKU Muhammadiyah Delanggu Hospital. MAP itself is an indicator of the average arterial pressure throughout the cardiac cycle (systole and diastole), and its value is primarily influenced by cardiac output and total peripheral resistance. An increase in MAP occurs due to an increase in one or both of these factors. Halery (2021) explains that women with preeclampsia experience endothelial dysfunction, leading to increased total peripheral resistance early in pregnancy. This condition can be detected before the appearance of clinical signs of preeclampsia.

This research aligns with the results of a study conducted by Listyowati in 2020 at Sekar Community Health Center, Bojonegoro Regency. The study found that subjects with Mean Arterial Pressure (MAP) in the mild hypertension category numbered 20 people (55.6%), while those experiencing mild preeclampsia numbered 24 people (66.6%). Based on the Chi-Square test, the obtained significance value (p-value) was 0.000, which is less than or equal to the significance level alpha (0.05). These results indicate a statistically significant relationship between Mean Arterial Pressure (MAP) and the incidence of preeclampsia.

The study by Kenny et al. (2014) focused on developing an accurate method for predicting the incidence of hypertension in pregnant women through Mean Arterial Pressure (MAP) measurement. Their study results showed that MAP values in pregnant women with preeclampsia were consistently higher compared to pregnant women with normal blood pressure. This finding is supported by other research. Akoleker (2012) reported a linear correlation between MAP and preeclampsia. Meanwhile, a study by Taslim et al. (2016) also obtained similar results, namely that MAP was significantly associated with hypertension in pregnancy. Furthermore, abnormal MAP was found to increase the risk of hypertension in pregnancy up to 11.69 times.

Suprihatin (2019), in her research at Pacar Keling Community Health Center Surabaya, found that almost all pregnant women had Mean Arterial Pressure (MAP) values exceeding >90 mmHg, and the majority of this group was diagnosed with positive preeclampsia. This result is consistent with Nining's study (2020), which concluded that pregnant women with positive MAP values tend to have a higher probability of suffering from preeclampsia compared to pregnant women whose MAP values are in the negative category.

Relationship between Body Mass Index (BMI) and Preeclampsia Incidence at Pakjo Community Health Center Palembang, 2023–2024 Period

The results of the bivariate analysis showed a significant relationship between High BMI (Overweight/Obesity) and the incidence of Preeclampsia (p-value < 0.001), with the OR value recorded as 8.381 times higher in pregnant women with High BMI compared to those with Normal BMI.

The findings in this study are consistent with the research conducted by Nurul Azizah et al. in 2020, entitled "The Relationship of BMI (Body Mass Index) with the Incidence of PE (Preeclampsia) in Pregnant Women." That study, located at Gondang District Community Health Center, Bojonegoro Regency, presented the BMI category distribution as follows: underweight (14.3% or 5 respondents), normal (31.4% or 11 respondents), overweight (11.4% or 4 respondents), obesity I (22.9% or 8 respondents), and obesity II (20% or 7 respondents). Furthermore, the distribution of preeclampsia incidence was: non-preeclampsia (68.6% or 24 respondents), mild preeclampsia (25.7% or 9 respondents), and severe preeclampsia (5.7% or 2 respondents). The Chi-Square test results showed a significance value of p = 0.01. Since p < 0.05, the alternative hypothesis (H1) was accepted, meaning there is a significant relationship between BMI and the incidence of preeclampsia.

Obesity is a major risk factor strongly associated with the development of preeclampsia. A study focusing on the pregnant female population in Pittsburgh indicated that the risk of preeclampsia increases threefold in pregnant women diagnosed with obesity. Furthermore, the majority of preeclampsia cases (both mild and severe) late in pregnancy are found in women categorized as overweight or obese. To identify overweight or obesity in the Asia Pacific population, the Body Mass Index (BMI) is used, where a value of 25 kg/m^2 is categorized as obesity. This excess BMI also potentially increases risk in the first trimester and the risk of miscarriage (Lashen, et al., 2004, in Cunningham, et al., 2014). The mechanism for the onset of preeclampsia in overweight pregnant women involves hyperleptinemia, metabolic syndrome, an inflammatory response, and increased oxidative stress, which collectively result in endothelial damage and dysfunction (Azizah, 2020).

The significant relationship between Body Mass Index (BMI) and preeclampsia cases in pregnant women is reinforced by the research of Fajaria Nur Aini (2023). This link is relevant considering the fairly high prevalence of obesity in Indonesia, which is 21.8%, and that women tend to have a greater probability of obesity compared to men.

The frequency of preeclampsia cases tends to be high in pregnant women with a Body Mass Index (BMI) in the overweight or obese categories. This finding is supported by the study of Vincent, Darmayasa, & Suardika (2018), which concluded that pregnant women with preeclampsia generally had a BMI within the overweight range. Correspondingly, various other studies also reinforce that BMI exceeding the normal limit significantly increases the probability of developing gestational toxicity or preeclampsia (Motedayen, Rafiei, Tavirani, Sayehmiri, & Dousti, 2019).Based on the definition by Handayani & Nurjanah (2021), preeclampsia is defined as a specific

inflammation. This pathological response involves the activation of the blood vessel lining (endothelium) and the blood clotting process (coagulation). Clinically, this condition is characterized by the triad of symptoms: hypertension, edema, and proteinuria; however, a diagnosis can be established only by finding hypertension along with proteinuria, or hypertension with edema. It is important to note that preeclampsia not only causes acute complications but is also linked to an increased risk of future cardiovascular disease (Dewie et al., 2020).

Pregnant women with an overweight or obese nutritional status (based on Body Mass Index/BMI) face a higher probability of preeclampsia compared to those with normal or

underweight BMI. This increased risk is rooted in the accumulation of excess body fat, which triggers degenerative diseases. The accumulated fat produces increased levels of C-Reactive Protein (CRP) and Interleukin 6 (IL-6), which are inflammatory cytokines. CRP, as an acute-phase reactant produced in adipose (fat) tissue, increases early in pregnancy, while IL-6 functions to stimulate acute-phase reactants that affect the blood vessel walls and coagulation system. The increase in both these substances contributes to oxidative stress. Oxidative stress, combined with toxic substances from excess fat, stimulates endothelial dysfunction—damage to the lining of the blood vessels. This endothelial dysfunction creates an imbalance between vasodilator (widening) and vasoconstrictor (narrowing, such as endothelin I, thromboxane, and angiotensin II) substances. Consequently, widespread vasoconstriction occurs, triggering hypertension. This prolonged vasospasm can further lead to organ failure, including the kidneys (resulting in proteinuria and kidney failure), hepatic ischemia, which ultimately triggers the full development of preeclampsia (Nulanda, 2019).

Multivariate Analysis

Relationship between Mean Arterial Pressure (MAP) and Body Mass Index (BMI) with Preeclampsia Incidence at Pakjo Community Health Center Palembang, 2023–2024 Period

Model Fit Test

The Binary Logistic Regression Analysis was performed to test the simultaneous effect of Body Mass Index (BMI) and Mean Arterial Pressure (MAP) on the incidence of Preeclampsia. The model fit was tested using the Hosmer and Lemeshow Test, which yielded a significance value of p=0.106. Since this p-value is greater than 0.05, it can be concluded that the established logistic regression model is fit and can be used to predict the risk of Preeclampsia in the research sample. Overall, the model was able to explain 31.3% of the variance in Preeclampsia incidence (based on the Nagelkerke OR value of 0.313) and had a prediction accuracy of 74%

Identification of the Dominant Independent Predictor

Based on the comparison of the p-value and Odds Ratio (OR), it can be concluded that Body Mass Index (BMI) is the most dominant predictor for the incidence of Preeclampsia in the pregnant women population at Pakjo Community Health Center. This finding is highly crucial as it underscores the need to focus interventions on obesity prevention and weight management from pre-conception through pregnancy, serving as the most powerful strategy to minimize the risk of Preeclampsia. After controlling for the Mean Arterial Pressure (MAP) variable, pregnant women with High BMI were proven to have a 4.848 times greater chance of experiencing Preeclampsia compared to pregnant women with Normal BMI. This confirms that the maternal status of overweight or obesity is a fundamental and independent risk factor.

The findings of this study are consistent with the results of the study, "Early Preeclampsia Prediction Through Measurement of Body Mass Index, Mean Arterial Pressure, and Roll Over Test," conducted by Endah Suprihatin and Sri Hardi Wuryaningsih (2019) at Pacar Keling Community Health Center Surabaya. That study concluded that the combination of Body Mass Index (BMI) and Mean Arterial Pressure (MAP) has an effective tendency to predict the incidence of preeclampsia early. Empirical evidence showed that out of eight pregnant women identified as having positive predictor factors, seven of them (90%) subsequently developed signs of preeclampsia after further evaluation.

Women experiencing obesity often have Metabolic Syndrome (MS), a condition characterized by hyperinsulinemia, abnormal placental glycogen accumulation, and impaired insulin signaling. This combination of factors plays a role in triggering preeclampsia and hypertension syndrome. Furthermore, the study by Tampubolon (2021) strengthens this finding, showing

that obesity correlates with the incidence of Preeclampsia (PE), and the BMI category of >30 kg/m^2 (obesity grade I and above) carries a higher risk for the onset of preeclampsia.

The increase in blood pressure during pregnancy is caused by the increased volume and blood requirements within the maternal circulatory system. Additionally, excessive maternal weight gain often triggers fluid retention, leading to edema (swelling), particularly in the face and extremities; this is known to be one of the early symptoms of preeclampsia. This finding is supported by the study of Lushinta (2022), which showed a correlation between Body Mass Index (BMI) and the incidence of preeclampsia.

Conclusion

There is a statistically highly significant relationship between Mean Arterial Pressure (MAP) $>90 \text{ mmHg}$ and the incidence of preeclampsia ($p\text{-value} < 0.001$).2. There is a statistically highly significant relationship between High Body Mass Index (BMI) (overweight and obese categories) and the incidence of Preeclampsia ($p\text{-value} < 0.001$).3. Mothers with positive MAP have a $\mathbf{6}$ times greater risk of preeclampsia compared to mothers with negative MAP.4. Mothers with overweight/obese BMI have an $\mathbf{8}$ times greater risk of preeclampsia compared to mothers with normal BMI.5. High Body Mass Index (BMI) is the most dominant risk factor and is a strong independent predictor for the incidence of Preeclampsia at Pakjo Community Health Center Palembang during the 2023–2024 period.

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