

DETERMINANTS OF PREECLAMPSIA IN PREGNANT WOMEN: A CASE-CONTROL STUDY

Khozinatul Munna Alfi Zulaikho^a, Mukhoirotin^{b*}, Herin Mawarti^c

^{a,b}Nursing Science Program, Faculty of Health Nursing, University of Pesantren Tinggi Darul Ulum,
Jombang, East Java, Indonesia

^cMaster of Health Sciences, University of Pesantren Tinggi Darul Ulum Jombang, East Java, Indonesia

*Corresponding e-mail: mukhoirotin@fik.unipdu.ac.id

ABSTRACT

Preeclampsia is a pregnancy complication that can increase the risk of maternal and perinatal morbidity and mortality. Identifying factors associated with preeclampsia is necessary to support the early detection of high-risk pregnancies. This study aimed to analyze the association of age, parity, history of hypertension, previous history of preeclampsia, and obesity with the incidence of preeclampsia and to determine the dominant factor. This study used an analytical observational design with a case-control approach involving 136 pregnant women, consisting of 68 cases and 68 controls. Data were obtained from medical records and analyzed using the chi-square test and logistic regression with $\alpha \leq 0.05$. The results showed that age ($p=0.860$; $OR=1.064$) and parity ($p=0.585$; $OR=1.221$) were not associated with the incidence of preeclampsia. A history of hypertension ($p<0.001$; $OR=9.242$), previous history of preeclampsia ($p<0.001$; $OR=24.100$), and obesity ($p=0.024$; $OR=2.218$) were associated with the incidence of preeclampsia. In the final logistic regression model, a history of hypertension had an $OR=20.000$, while a previous history of preeclampsia had an $OR=72.000$. A previous history of preeclampsia was the dominant factor associated with the incidence of preeclampsia among pregnant women in the Drupadi Ward of Jombang Regional General Hospital. Screening for a history of preeclampsia and hypertension, along with blood pressure monitoring, should be optimized during antenatal visits to support the early detection of preeclampsia.

Keywords: preeclampsia; history of hypertension; previous history of preeclampsia; obesity; risk factors

INTRODUCTION

Preeclampsia is a hypertensive disorder of pregnancy that can cause multisystem disorders in the mother and have serious effects on maternal and perinatal outcomes. The condition is characterized not only by elevated blood pressure but may also be accompanied by maternal organ dysfunction. Globally, preeclampsia is estimated to affect approximately 2–8% of pregnancies and remains an important cause of maternal

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and perinatal morbidity and mortality (Ives et al., 2020). The magnitude of this problem highlights the importance of early detection of pregnant women with risk factors for preeclampsia. Identification of risk factors from the antenatal visit may help healthcare professionals determine women who require more intensive monitoring during pregnancy (Macedo et al., 2020).

In Indonesia, preeclampsia also remains one of the major maternal health problems. Data cited in a national study indicate that the incidence of preeclampsia in Indonesia is estimated at approximately 3.3%, although this figure should be interpreted according to the data source and population characteristics used (Simbolon et al., 2025). This condition indicates that efforts to prevent and detect preeclampsia early are still needed in maternal and child health services. In East Java, preeclampsia/eclampsia is also an important cause of maternal mortality. East Java data in 2019 showed that preeclampsia/eclampsia accounted for 31.15% of the causes of maternal death, making the recognition of risk factors and early detection important components of antenatal care (Susanti et al., 2022). A similar problem was also identified at the healthcare service level in Jombang Regency. Jombang Regional General Hospital recorded 470 patients with preeclampsia in 2022, with an average of approximately 40 patients per month (RSUD Jombang, 2022).

The pathogenesis of preeclampsia is complex and multifactorial. Impaired placental implantation and development may result in abnormal placental perfusion, followed by the release of antiangiogenic mediators and maternal endothelial dysfunction. Increased soluble fms-like tyrosine kinase-1 (sFlt-1) and soluble endoglin (sEng) contribute to endothelial dysfunction, vasoconstriction, and impaired function of various maternal organs. These conditions indicate that preeclampsia is a systemic syndrome involving interactions between the placenta and the maternal response (Ives et al., 2020).

Maternal factors play an important role in determining the risk of preeclampsia. Several factors that have been widely reported to be associated with preeclampsia include maternal age, nulliparity, obesity, diabetes, chronic hypertension, kidney disease, and previous history of preeclampsia (Ives et al., 2020). Hypertension that exists before pregnancy is an important factor in the development of hypertensive disorders of pregnancy. In women with chronic hypertension, the risk of superimposed preeclampsia is increased, and this condition is associated with higher maternal and perinatal morbidity (Kametas et al., 2022).

A previous history of preeclampsia is also important in determining risk in subsequent pregnancies (Meazaw et al., 2020). Studies have shown that women with a history of preeclampsia are at risk of developing preeclampsia again in subsequent pregnancies and require more regular antenatal monitoring. In addition to a history of disease, obesity is also associated with an increased risk of preeclampsia. Weight gain and obesity may be associated with metabolic and vascular changes that contribute to hypertensive disorders of pregnancy (He et al., 2020). A study at Kayuagung Regional General Hospital in 2021 found an association between obesity and preeclampsia (Dasarie et al., 2023). Maternal age and parity are also frequently used as components



of maternal risk assessment. A study in Tangerang showed associations between age, parity, body mass index, and preeclampsia, whereas other studies have reported different findings in certain population characteristics (Latipah et al., 2023).

Preeclampsia may also have health consequences after delivery. A multicenter cohort study showed that six months after delivery, 71% of women with preterm preeclampsia still had hypertension and 10% had a left ventricular ejection fraction <55%. These findings indicate that preeclampsia does not necessarily end as a problem during pregnancy but may also serve as a marker of long-term cardiovascular health risk (Mccarthy et al., 2021).

Although many studies have investigated risk factors for preeclampsia, the findings still vary between populations. Therefore, research providing an overview of factors associated with preeclampsia based on the characteristics of pregnant women receiving care is important. Based on this background, this study aimed to analyze the associations of age, parity, history of hypertension, previous history of preeclampsia, and obesity with preeclampsia and to determine the most dominant factor among pregnant women in the Drupadi Ward of Jombang Regional General Hospital.

METHODS

This study used a quantitative analytical observational design with a retrospective case-control approach. The study was conducted in Drupadi Ward 2 of Jombang Regional General Hospital using medical record data of pregnant women for the January–December 2022 period. The sample consisted of 136 respondents, comprising 68 women with preeclampsia as the case group and 68 women without preeclampsia as the control group. Sampling was performed using simple random sampling after selection according to the inclusion and exclusion criteria. The inclusion and exclusion criteria were applied to define the eligible study population and ensure that respondents met the predefined characteristics and had complete and relevant medical record data. Simple random sampling was then conducted among the eligible respondents, giving each eligible respondent an equal opportunity to be selected.

The dependent variable was the incidence of preeclampsia, while the independent variables included age, parity, history of hypertension, previous history of preeclampsia, and obesity. Secondary data were obtained from medical records using an observation sheet covering maternal characteristics, obstetric history, medical history, and anthropometric data. Data were processed through editing, coding, processing, and cleaning, and were then analyzed using SPSS version 23. Univariate analysis was used to describe the distribution of study variables, while bivariate analysis used the chi-square test to determine the association of each independent variable with preeclampsia. The significance level was set at $\alpha \leq 0.05$.

Variables meeting the analysis criteria were subsequently entered into logistic regression to determine the dominant factor which consists of two stages. In Step 1, all variables that met the predefined criteria for multivariate analysis were simultaneously entered into the logistic regression model, namely history of hypertension, previous history of preeclampsia, and obesity. The purpose of this step

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was to assess the independent association of these variables with preeclampsia while controlling for the effects of the other variables. In Step 2, obesity was removed from the model because its p-value was 0.182, which did not meet the significance criterion ($\alpha \leq 0.05$). The logistic regression analysis was then repeated with the remaining variables, namely history of hypertension and previous history of preeclampsia. In the final model, previous history of preeclampsia had the highest OR (72.000), compared with history of hypertension (OR=20.000), and was therefore identified as the dominant factor associated with preeclampsia.

Data collection was conducted after the study was declared ethically approved by the Health Research Ethics Committee of Jombang Regional General Hospital, as evidenced by the issuance of an ethical clearance certificate (No. 49/KEPK/V/2023).

RESULTS

The characteristics of respondents in this study included occupation, history of diabetes mellitus, and history of kidney disease (Table 1).

Table 1. Characteristics of research respondents

No	Variable	Preeclampsia			
		Yes		No	
		Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
1.	Occupation				
	Employed	17	25	13	19.1
	Unemployed	51	75	55	80.9
2.	History of diabetes mellitus				
	Yes	4	5.9	5	7.4
	No	64	94.1	63	92.6
3.	History of kidney disease				
	Yes	0	0	2	2.9
	No	68	100	66	97.1

Regarding occupation, almost all respondents in both groups were not working, comprising 51 (75%) in the case group and 55 (80.9%) in the control group. Almost all respondents in the case group (94.1%) and control group (92.6%) had no history of diabetes mellitus. None of the respondents in the case group had a history of kidney disease, and almost all respondents (97.1%) in the control group had no history of kidney disease.

Table 2. Determinants of preeclampsia in pregnant women

No	Variable	Preeclampsia				P	OR	95% CI (Lower – Upper)
		Yes		No				
		N	%	N	%			
1.	Age					0.860	1.064	

No	Variable	Preeclampsia				P	OR	95% CI (Lower – Upper)
		Yes		No				
		N	%	N	%			
	At risk (<20 or >35 years)	27	39.7	26	38.2			0.534–2.119
	Not at risk (20–35 years)	41	60.3	42	61.8			
2.	Parity							
	At risk	24	35.3	21	30.9	0.585	1.221	0.597–2.497
	Not at risk	44	64.7	47	69.1			
3.	History of hypertension							
	Yes	35	51.5	7	10.3	<0.001	9.242	3.700–23.085
	No	33	48.5	61	89.7			
4.	Previous history of preeclampsia							
	Yes	18	26.5	1	1.5	<0.001	24.100	3.115–186.700
	No	50	73.5	67	98.5			
5.	Obesity							
	Yes	35	51.5	22	32.4	0.024	2.218	1.106–4.448
	No	33	48.5	46	67.6			

Chi-square Test

The results showed that age and parity were not associated with preeclampsia ($p > 0.05$). There was a significant association between history of hypertension ($p < 0.05$; $OR = 9.242$), indicating that the odds of preeclampsia were 9.242 times higher among respondents with a history of hypertension than among respondents without a history of hypertension. There was a significant association between previous history of preeclampsia and preeclampsia ($p < 0.05$; $OR = 24.100$). This indicates that the odds of preeclampsia were 24.100 times higher among respondents with a previous history of preeclampsia than among respondents without such a history. There was a significant association between obesity and preeclampsia ($p < 0.05$; $OR = 2.218$). This indicates that the odds of preeclampsia were 2.218 times higher among respondents with obesity than among respondents without obesity.

Table 3. Dominant factors associated with preeclampsia

Model	Variable	B	P value	OR	95% CI (Lower – Upper)
Step 1	History of hypertension	2.959	<0.001	19.280	7.115–52.243
	Previous history of preeclampsia	4.235	<0.001	69.033	8.471–562.563
	Obesity	0.629	0.182	1.875	0.744–4.724
Step 2	History of hypertension	2.996	<0.001	20.000	7.437–53.785
	Previous history of preeclampsia	4.277	<0.001	72.000	8.891–583.074

Logistic Regression Analysis



The variables meeting the criteria for multivariate analysis were history of hypertension, previous history of preeclampsia, and obesity. In the first step, history of hypertension had an OR=19.280, previous history of preeclampsia had an OR=69.033, and obesity had an OR=1.875. Obesity had $p=0.182$ and was therefore removed from the model in the second step. In the final model, history of hypertension had an OR=20.000, whereas previous history of preeclampsia had an OR=72.000. Thus, previous history of preeclampsia had the highest OR and was designated as the dominant factor in this study. The OR for previous history of preeclampsia increased slightly from 69.033 in Step 1 to 72.000 in Step 2 after obesity was removed from the model. This change reflects the adjustment of the multivariable model following the removal of obesity, which did not meet the predefined significance criterion ($p=0.182$). The 95% confidence interval for previous history of preeclampsia remained wide in the final model (8.891–583.074), indicating limited precision in the estimated OR. This wide interval may be related to the small number of respondents with a previous history of preeclampsia, particularly in the control group. Nevertheless, the confidence interval remained entirely above 1 and the association remained statistically significant ($p<0.001$). Therefore, previous history of preeclampsia was retained as the dominant factor based on its highest OR in the final model, while the magnitude of the OR should be interpreted with caution.

DISCUSSION

The results showed that maternal age was not significantly associated with preeclampsia ($p=0.860$; OR=1.064; 95% CI=0.534–2.119). In the case group, 27 respondents (39.7%) were categorized as being in the at-risk age group (<20 years or >35 years), while 41 respondents (60.3%) were aged 20–35 years; in the control group, the respective proportions were 38.2% and 61.8%. The relatively similar distribution between the case and control groups may explain why no statistically significant association between age and preeclampsia was found in this study.

Biologically, extreme maternal age is often considered a risk factor for preeclampsia because pregnancy at a very young or older age may be accompanied by different physiological characteristics and comorbidities (Ives et al., 2020). However, the absence of an association in this study indicates that age alone is not sufficient to explain the occurrence of preeclampsia in the study population, particularly because other maternal factors showed stronger associations..

These findings differ from a previous study at Arjawinangun Regional General Hospital, which found a significant association between age and severe preeclampsia/eclampsia ($p=0.000$), with age being the dominant factor in multivariate analysis (Bardja, 2020). The difference may be related to differences in population characteristics, age categories used, types of cases studied, and the distribution of other risk factors in each study group. A literature review also showed that the association between age and preeclampsia is not always consistent across regions and populations (Hanifa & Cahyani, 2023). Therefore, the findings of this study indicate that categorizing women solely according to at-risk and not-at-risk age should be

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considered together with other factors, particularly history of hypertension and previous history of preeclampsia, which showed much stronger associations in this study. Thus, these findings do not mean that age has no clinical relevance, but indicate that among pregnant women studied at Jombang Regional General Hospital, age was not the factor that statistically most determined the occurrence of preeclampsia. Risk assessment should remain comprehensive by considering medical and obstetric history rather than maternal age alone.

The results showed that parity was not significantly associated with preeclampsia ($p=0.585$; $OR=1.221$; $95\% CI=0.597-2.497$). In the case group, 24 respondents (35.3%) had at-risk parity, namely primiparity and grand multiparity, while 44 respondents (64.7%) were multiparous; in the control group, the respective numbers were 21 respondents (30.9%) and 47 respondents (69.1%). An OR of 1.221 indicates that, by estimation, the primiparous or grand multiparous group had approximately 1.2 times the odds of preeclampsia compared with the multiparous group; however, the 95% confidence interval included 1 and the p -value was greater than 0.05, so the association could not be considered statistically significant. This finding is important because it shows that a numerically larger OR does not necessarily indicate a statistically convincing association.

Parity, particularly primigravidity, is often associated with preeclampsia through immunological mechanisms and maternal adaptation to the first pregnancy. However, this association may be influenced by other factors such as maternal age, chronic hypertension, obesity, and previous history of preeclampsia (Ives et al., 2020).

These findings differ from a previous study that found an association between parity and severe preeclampsia/eclampsia ($p=0.003$) (Bardja, 2020). The difference may have occurred because the studies used different populations and case characteristics, whereas the study at Jombang Regional General Hospital used 68 cases (preeclampsia) and 68 controls (without preeclampsia), with a relatively similar distribution of parity between the two groups. A literature review also showed that the association between parity and preeclampsia may differ across populations (Hanifa & Cahyani, 2023). Furthermore, a study at A Purwakarta General Hospital in 2021 using medical record data also showed that maternal characteristics did not all have the same association with severe preeclampsia (Yeyeh R et al., 2021). Thus, the absence of an association with parity in this study indicates that parity was not a dominant factor in the study population; therefore, attention in risk detection should be directed toward factors showing stronger associations, particularly history of hypertension and previous history of preeclampsia.

In contrast to age and parity, this study found a strong association between history of hypertension and preeclampsia ($p<0.001$; $OR=9.242$; $95\% CI=3.700-23.085$). A total of 35 respondents (51.5%) in the case group had a history of hypertension, whereas only 7 respondents (10.3%) in the control group had such a history. An OR of 9.242 indicates that women with a history of hypertension had approximately 9.2 times higher odds of developing preeclampsia than women without a history of hypertension in this study population. Although the 95% confidence interval was relatively wide



(3.700–23.085), the entire interval remained above 1, indicating a consistent positive association between a history of hypertension and preeclampsia. The wide confidence interval indicates that the estimated OR has limited precision, which may be related to the relatively small number of respondents with a history of hypertension, particularly in the control group. Therefore, the OR of 9.242 should be interpreted as an estimate of the strength of association rather than as an exact measure of risk. Nevertheless, the statistically significant p-value ($p < 0.001$) and the confidence interval that did not include 1 support the presence of a significant association between a history of hypertension and preeclampsia in this study population.

Pathophysiologically, chronic hypertension may reflect pre-existing vascular and cardiometabolic disorders, making women with this condition more susceptible to hypertensive disorders during pregnancy. Chronic hypertension is an important risk factor for preeclampsia and superimposed preeclampsia (Ives et al., 2020). This association is particularly important because chronic hypertension and preeclampsia may be related through vascular dysfunction that existed before pregnancy and physiological changes during pregnancy (Ives et al., 2020). Therefore, a history of hypertension is not merely an element of the medical history but may indicate that a woman had vascular susceptibility before pregnancy.

These findings are consistent with previous research identifying a history of hypertension as one of the factors associated with preeclampsia (Hanifa & Cahyani, 2023). A study by (Tamaledu et al., 2023) at Prof. Dr. R. D. Kandou General Hospital, Manado, also included a history of hypertension as a maternal factor associated with preeclampsia. These findings have practical implications: a history of hypertension should be asked about and documented from the beginning of antenatal care because its presence can help identify women who require closer monitoring.

Previous history of preeclampsia was one of the most important findings in this study. Bivariate analysis showed a highly significant association between previous history of preeclampsia and preeclampsia ($p < 0.001$; OR=24.100; 95% CI=3.115–186.700). In the case group, 18 respondents (26.5%) had a previous history of preeclampsia, whereas only 1 respondent (1.5%) in the control group had such a history. An OR of 24.100 indicates that women with a previous history of preeclampsia had approximately 24 times higher odds of developing preeclampsia than women without such a history in this study population. Although the 95% confidence interval was wide (3.115–186.700), the entire interval remained above 1, indicating a consistent positive association between previous history of preeclampsia and preeclampsia. The wide confidence interval indicates limited precision in the estimated OR. This may be related to the relatively small number of respondents with a previous history of preeclampsia, particularly in the control group, where only one respondent had such a history. The marked difference in the distribution of previous history of preeclampsia between the case and control groups may therefore contribute to the wide confidence interval. Consequently, the OR of 24.100 should be interpreted as an estimate of the strength of association rather than as an exact measure of risk. Nevertheless, the statistically significant p-value ($p < 0.001$) and the confidence interval remaining entirely



above 1 support the presence of a significant association between previous history of preeclampsia and preeclampsia in this study population.

These findings are consistent with previous research stating that preeclampsia in a previous pregnancy is an important predictor of recurrence in a subsequent pregnancy. A study by (Coban, 2020) found recurrent preeclampsia in 55.5% of women in subsequent pregnancies, making a history of preeclampsia important clinical information for monitoring subsequent pregnancies.

Another study of women with a history of very early-onset preeclampsia also showed that approximately 20.8% experienced recurrent preeclampsia in a subsequent pregnancy (Gottardi et al., 2021). Differences in recurrence rates between studies indicate that the risk is not uniform and may be influenced by gestational age at the occurrence of previous preeclampsia, disease severity, chronic hypertension, and other maternal characteristics (Gottardi et al., 2021).

Biologically, a history of preeclampsia may reflect maternal or vascular characteristics that persist after the previous pregnancy has ended, making women more susceptible in subsequent pregnancies (Ives et al., 2020). Because the mechanisms of recurrence are multifactorial, a history of preeclampsia should be regarded as a risk marker rather than the sole cause of the disease.

These findings are also consistent with previous research showing that previous history of preeclampsia can be used as information for risk screening. Tamaledu et al. (2023), specifically identified a history of preeclampsia as an important factor in identifying women at risk, particularly in healthcare settings with limited resources.

This study showed that obesity was significantly associated with preeclampsia ($p=0.024$; $OR=2.218$; $95\% CI=1.106-4.448$). In the case group, 35 respondents (51.5%) had obesity, compared with 22 respondents (32.4%) in the control group. An OR of 2.218 indicates that women with obesity had approximately 2.2 times higher odds of developing preeclampsia than women without obesity in this study. These findings indicate that weight status is a factor that should be considered in maternal risk assessment.

These findings are consistent with a meta-analysis of 19 cohort studies showing that prepregnancy overweight was associated with an increased risk of preeclampsia with an $aOR=1.71$, whereas obesity was associated with preeclampsia with an $aOR=2.48$ (He et al., 2020). The association between obesity and preeclampsia can be explained through various mechanisms related to endothelial dysfunction, inflammation, oxidative stress, and metabolic disorders. These conditions may increase maternal vascular susceptibility and contribute to the pathophysiological processes underlying preeclampsia (Ives et al., 2020). These findings are also consistent with previous research showing an association between obesity and preeclampsia (Tamaledu et al., 2023).

Previous history of preeclampsia was the dominant factor because it had the highest OR compared with history of hypertension. This finding is consistent with the literature identifying previous history of preeclampsia as an important predictor of preeclampsia in subsequent pregnancies (Coban, 2020). The dominance of previous



preeclampsia also has clinical significance because this information can be obtained through a simple history during the initial antenatal visit. Therefore, documenting a history of preeclampsia in a previous pregnancy can be an important component of risk stratification for pregnant women, particularly in referral healthcare facilities.

A history of hypertension also remained an important factor because it retained a high OR after previous history of preeclampsia was included in the model. These findings support the view that preeclampsia is associated with maternal vascular and cardiometabolic conditions that already exist before pregnancy, rather than being solely a disorder that suddenly develops during pregnancy (Ives et al., 2020).

CONCLUSION

Previous history of preeclampsia was the dominant factor associated with preeclampsia in this study. History of hypertension and obesity were also significantly associated with preeclampsia, whereas age and parity were not significantly associated with preeclampsia. Therefore, antenatal screening should prioritize the identification of a previous history of preeclampsia and a history of hypertension, accompanied by blood pressure monitoring and education regarding the warning signs of preeclampsia.

IMPLICATIONS FOR NURSING PRACTICE

The findings of this study imply that preeclampsia risk screening should not focus only on age and parity but should place greater attention on history of hypertension and previous history of preeclampsia. Both factors can be obtained through medical history and medical records and are therefore relatively easy to incorporate into risk assessment during antenatal visits. Obesity should also be considered because it showed a significant association in the bivariate analysis. Thus, a more appropriate healthcare approach is risk stratification based on a combination of factors rather than using a single maternal characteristic separately. This approach is consistent with the multifactorial nature of preeclampsia and its interaction with maternal predisposition, vascular and metabolic conditions, and pregnancy-related factors.

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ETHICAL STATEMENT AND CONFLICT OF INTEREST

The research data were obtained from patients' medical records at Jombang Regional General Hospital and were used solely for research purposes. The Khozinatul Munna Alfi Zulaikho et al., *Determinants Of Preeclampsia...*



confidentiality of patient identities and information was maintained throughout the data collection, processing, analysis, and reporting processes. The authors declare that there is no conflict of interest related to the research, authorship, and publication of this article.

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