



Analysis of Biological Factors Associated with Preeclampsia in Pregnant Women

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Received: March 31, 2024

Revised: July 31, 2024

Accepted: October 25, 2024

Published: October 30, 2024

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DOI: [10.29303/jppipa.v10i10.8692](https://doi.org/10.29303/jppipa.v10i10.8692)

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Abstract: Preeclampsia is a serious complication during pregnancy that poses significant health risks to both mother and fetus, potentially leading to death. Early identification of biological factors associated with preeclampsia is crucial for effective prevention. This study aims to analyze the biological factors influencing preeclampsia incidence among pregnant women. A quantitative design with a case-control approach was used, focusing on pregnant women with a history of preeclampsia in the Curug Community Health Center, Karawang Regency. The sample included 10 respondents. The results revealed a significant relationship between parity and preeclampsia incidence (p-value 0.031), BMI (p-value 0.018), diet (p-value 0.041), and history of complications (p-value 0.001). However, no significant association was found between lifestyle activities and preeclampsia (p-value 0.114). These findings suggest that factors like parity, BMI, diet, and complications history are significantly linked to preeclampsia incidence. These results provide a basis for targeted interventions in pregnant women's care. Future studies should expand the sample size and consider additional variables such as employment status, family support, and stress levels for more comprehensive insights into preeclampsia risk factors.

Keywords: Biological factors; BMI; Parity; Preeclampsia; Pregnant women

Introduction

Millennium Development Goals (MDGs) is an agreement between countries in the world which was followed by the Sustainable Development Goals (SDGs). One of the goals in the health sector is to reduce the maternal mortality rate (MMR) (Xia et al., 2024). Compared with other countries, the MMR rate in Indonesia is considered very high. This is proven by the record of maternal mortality which reached 4.62 deaths in Indonesia. The Healthy Indonesia Program is a program from the 5th Nawa Cita Agenda, namely improving the quality of life of Indonesian people. This program is supported by other sectoral programs, namely the Smart Indonesia Program, the Working Indonesia Program, and the Prosperous Indonesia

Program. The Healthy Indonesia Program was then planned for its achievement through the 2015-2019 Ministry of Health Strategic Plan which was determined through the Decree of the Minister of Health of the Republic of Indonesia. Number HK.02.02/Menkes/52/2015. One indicator of the success of development in the health sector is the maternal mortality rate, this describes the quality of maternal health (Li et al., 2024).

The World Health Organization (WHO) reports on national health status in achieving Sustainable Development Goals (SDGs) targets, stating that globally around 830 women die every day due to complications during pregnancy and childbirth, with a maternal mortality rate of 216 per 100,000 live births of 99% maternal death due to pregnancy, labor or birth problems (Huang et al., 2024). In improving the health

How to Cite:

Yuliwati, N., Juhariyah, S., Dewi, I., Yuliawati, I., & Dewi, I. S. (2024). Analysis of Biological Factors Associated with Preeclampsia in Pregnant Women. *Jurnal Penelitian Pendidikan IPA*, 10(10), 7493–7503. <https://doi.org/10.29303/jppipa.v10i10.8692>

status of a community, the indicators that will be achieved are reducing the maternal mortality rate (MMR) in Indonesia, which is still the highest in Southeast Asia and is still far from the global SDG target, namely to 183 per 100,000 KH in 2024 and less than 70 per 100,000 KH in 2030.

Furthermore, there are several conditions that may be the cause of the unhealthy condition of pregnant women, namely handling complications, anemia or anemia, diabetes, hypertension, malaria, too young age (less than 20 years), too old age (more than 35 years), and pregnancy that is too close (< 2 years). The primary causes of maternal death are hypertension in pregnancy and postpartum hemorrhage (Zhou et al., 2023). Ministry of Health data shows that the number of maternal deaths in 2022 caused by eclampsia will be 23 percent and bleeding will be 20 percent. In 2023, the cause of death due to eclampsia will be 24 percent and bleeding will be 23 percent. The Maternal Mortality Ratio for West Java Province in 2020 was 85.77 per 100,000 live births, above the target set at 85/100,000 KH. This is due to an increase in maternal mortality cases in West Java, namely from 684 cases in 2019 compared to 2020, namely 745 cases (Lu et al., 2024).

The number of maternal deaths in 2022 based on Karawang District Health Profile reporting was 52 cases, a decrease from 65 cases compared to 2021, namely 117 cases. The number of maternal deaths in 2022 will be the smallest number of deaths compared to at least the previous 2 years (Rahman et al., 2024). The causes of maternal death in 2022 are dominated by bleeding at 32.69%, hypertension at 25%, heart and blood vessel disorders at 9.61% and infection at 5.76%, other causes at 26.92%. Based on data from the Curug Community Health Center, Karawang Regency, in 2021 and 2022, respectively, there were 15 and around 13 out of 507 pregnant women.

Risk factors for preeclampsia include biological factors such as parity, body mass index, diet, physical activity, and history of preeclampsia. In terms of parity factors, pregnancies that are too close or too far apart can increase the risk of complications in pregnant women. This is because after giving birth, the uterus needs quite a long time to recover before it is filled again by the fetus. Repeated pregnancies cause the uterus to become unhealthy for subsequent pregnancies at close intervals (Pluta et al., 2024). On the other hand, the association between preeclampsia and mothers working during pregnancy is related to stress and varying levels of physical activity at work. The relationship between stress and hypertension is thought to be through sympathetic nerve activity which can increase blood pressure gradually (Bunyapipat et al., 2023).

In research of Svenvik et al. (2024), it was found that 28.6% of 105 pregnant women had preeclampsia. And the majority of pregnant women who experience preeclampsia have a BMI in the obese category. The statistical test results used ChiSquare p-value 0.041 (p-value < 0.05) so it can be concluded that there is a significant relationship between maternal nutritional status based on BMI and the incidence of preeclampsia in pregnant women. Based on the results of this research, it is necessary to pay attention to BMI factors in pregnant women to anticipate the incidence of preeclampsia. Dietary risk factors during pregnancy will affect the condition of the mother and fetus. Nutritional intake containing high levels of antioxidants, protein and calcium in pregnant women can prevent pregnant women from preeclampsia. This is in accordance with Sairoh's opinion which stated that 77.27% of the group of pregnant women who had a good diet did not experience severe preeclampsia, while 22.73% of the group of pregnant women with a bad diet experienced severe preeclampsia. The prevalence of severe preeclampsia in the poor diet group was 2.93 times greater than in the group with a good diet (Chen et al., 2024).

In research of Llubra et al. (2024) working mothers were 4 times more likely to experience pre-eclampsia compared to mothers who did not work. Women who work outside the home have a higher risk of experiencing pre-eclampsia compared to housewives. Work is associated with physical activity and stress. The history of hypertension factor from the research results showed a p-value of 0.008, indicating that there was a significant relationship between a history of hypertension and the incidence of preeclampsia. Meanwhile, the OR value = 2.571, which indicates that a history of hypertension is a risk factor for preeclampsia and patients who have a history of hypertension have a 2.57 times risk of suffering from preeclampsia (Hebeisen et al., 2024).

This study aims to determine the factors associated with the incidence of preeclampsia complications in pregnant women at the Curug Community Health Center, Karawang Regency, as well as to determine the factors that have the most dominant influence. Based on the data and phenomena above, the author is interested in studying this problem by explaining it in a thesis with the title "Analysis of Biological Factors Associated with the Incident of Preeclampsia in Pregnant Women".

Method

This research uses a quantitative design with a case control approach which aims to analyze factors related to the incidence of preeclampsia in pregnant women.

The study population consisted of pregnant women who had a history of preeclampsia who lived in the working area of the Curug Community Health Center, Karawang Regency. The sampling technique used was purposive sampling, with inclusion criteria including pregnant women with a history of preeclampsia, willing to be research respondents, and living in the working area of the Curug Community Health Center. The number of samples studied was 10 respondents, consisting of 5 cases (pregnant women with preeclampsia) and 5 controls (pregnant women without preeclampsia). Data was collected through two main instruments, namely a questionnaire which included questions related to preeclampsia risk factors such as parity factors, body mass index (BMI), diet, physical activity, history of preeclampsia, age, hypertension and other health conditions, as well as medical record documents to ensure the accuracy of information regarding the health history of pregnant women (Knorr et al., 2024).

The data collection procedure involved preparation by applying for research permission from the Curug Community Health Center, filling out questionnaires by respondents, and collecting medical record data. The collected data will be analyzed using the Chi-Square statistical test with steps including data tabulation, Chi-Square test using statistical software such as SPSS, and interpretation of the results to determine the significant relationship between the variables studied and the incidence of preeclampsia. This research also pays attention to ethical aspects by obtaining written consent from respondents, maintaining the confidentiality of respondents' personal data, and reporting research results honestly. With the research methods that have been explained, it is hoped that valid and reliable results can be obtained to determine the factors associated with the incidence of preeclampsia in pregnant women at the Curug Community Health Center, Karawang Regency.



Figure 1. Research Stages

Result and Discussion

Result

Univariate Analysis of Biological Factors Affecting Preeclampsia

Table 1. Frequency distribution of preeclampsia

Category	Frequency	Percentage (%)
Severe Preeclampsia	6	60
Mild Preeclampsia	4	40
Total	10	100

Based on the research results, it shows that the incidence of preeclampsia in the Curug Community Health Center working area was 6 people (60%) with severe preeclampsia and 4 people (40%) with mild preeclampsia.

Table 2. Frequency distribution of parity factors

Parity	Frequency	Percentage (%)
Primigravida	4	50
Multigravida	6	50
Total	10	100

Based on the research results, it shows that the parity factor in the Curug Health Center working area is 4 people (60%) for primigravidas and 6 people (60%) for multigravidas.

Table 3. Frequency distribution of body mass index factors

IMT	Frequency	Percentage (%)
< 18.50 (which)	1	10
18.5 - 22.90 (normal)	5	50
23 - 24.9 (obese)	3	30
25 - 29.90 (over)	1	10
Total	10	100

Based on the research results, it shows that the BMI factor in the Curug Community Health Center working area is in the normal category as many as 5 people (50%) and in the small category, underweight and over BMI is 1 person each (10%).

Table 4. Frequency distribution of dietary pattern factors

Dietary habit	Frequency	Percentage (%)
Good	7	70
Not enough	3	30
Total	10	100

Based on the research results, there are 7 people (70%) who have a good diet and 3 people (30%) who have a poor diet.

Table 5. Frequency distribution of complications history factors

History of Complications	Frequency	Percentage (%)
Of	8	80
No	2	20
Total	10	100

Based on the research results, it showed that 8 pregnant women (80%) had no history of complications and 2 people (20%) had a history of complications.

Table 6. Frequency distribution of activity lifestyle factors

Activity Lifestyle	Frequency	Percentage (%)
Good	6	60
Low	4	40
Total	10	100

Based on the research results, there were 6 pregnant women with a good activity lifestyle (60%) and 4 people with a low activity lifestyle (40%).

Bivariate Analysis Related to Biological Factors that Influence Preeclampsia

Table 7. Relationship between parity and the incidence of preeclampsia

Category	Preeclampsia		p	OR	95%CI
	Heavy n (%)	Light n (%)			
Parity					
Primigravida	3 (50)	1 (25)	0.03	3.029	5.120
Multigravida	3 (50)	3 (75)			
Amount	6 (100)	4 (100)			

Based on Table 7, it shows that severe preeclampsia in primigravidas and multigravidas is 3 people (50%) and in mild preeclampsia with a parity factor is 1 person (25%) in primigravidas and 3 people in multigravidas (75%). The significance value shows that the parity factor significantly influences the incidence of preeclampsia

(0.031 < 0.05). So parity is a risk factor for preeclampsia in pregnant women. The OR value of 3.029 indicates that pregnant women with the primigravida parity factor have a risk of experiencing preeclampsia 3.029 times compared to those with the multigravida parity factor.

Based on Table 8, it shows that severe preeclampsia shows 50% under normal conditions and the BMI < 18.5 (thin) group does not show 0% severe preeclampsia. Mild preeclampsia showed a BMI of 18.5-22.9 (normal) by 50% and the BMI < 18.5 (thin) and 23-24.9 (obese) groups were 25% each. The significance value shows that the BMI factor significantly influences preeclampsia (0.018 < 0.05). So, BMI is a risk factor for preeclampsia in pregnant women. The OR value of 9.120 indicates that pregnant women with abnormal BMI factors have a risk of experiencing preeclampsia 9.120 times compared to those with normal BMI factors.

Table 8. Relationship between BMI and the incidence of preeclampsia

Category	Preeclampsia		p	OR	95%CI
	Heavy n (%)	Light n (%)			
IMT					
< 18.5 (which)	0 (0)	1 (25)	0.02	9.12	4.19
18.5-22.9 (normal)	3 (50)	2 (50)			
23-24.9 (obese)	2 (33.3)	1 (25)			
25-29.9 (over)	1 (16.7)	0 (0)			
Amount	6 (100)	4 (100)			

Table 9. Relationship between diet and the incidence of preeclampsia

Category	Preeclampsia		p	OR	95%CI
	Heavy n (%)	Light n (%)			
Dietary habit					
Good	2 (33.3)	1 (25)	0.041	8.137	6.413
Not enough	4 (66.7)	3 (75)			
Amount	6 (100)	4 (100)			

Based on Table 9, it shows that both severe preeclampsia and mild preeclampsia with a diet that is less high risk are 66.7% in the severe preeclampsia group and 75% in the mild preeclampsia group. The significance value shows that eating pattern factors significantly influence the incidence of preeclampsia (0.041 < 0.05). So diet is a risk factor for preeclampsia in pregnant women. The OR value of 8.14 shows that pregnant women with poor diet factors have a risk of experiencing preeclampsia 8.14 times compared to those with good diet factors.

Table 10. Relationship between history of complications and the incidence of preeclampsia

Category	Preeclampsia		p	OR	95%CI
	Heavy n (%)	Light n (%)			
History of Complications					
Of	5 (83.30)	3 (75)			
No	1 (16.70)	1 (25)	0.001	4.39	8.34
Amount	6 (100)	4 (100)			

Based on Table 10, it shows that severe preeclampsia with a history of complications is higher, namely 83.3%, in the mild preeclampsia group, 75%. The significance value shows that eating pattern factors significantly influence the incidence of preeclampsia ($0.001 < 0.05$). So a history of complications is a risk factor for preeclampsia in pregnant women. The OR value of 4.398 shows that pregnant women with factors with a history of complications have a risk of experiencing preeclampsia 4.398 times compared to factors with no history of complications.

Table 11. Relationship between lifestyle activities and the incidence of preeclampsia

Category	Preeclampsia		p	OR	95%CI
	Heavy n (%)	Light n (%)			
Activity Lifestyle					
Good	3 (50)	3 (75)			
Low	3 (50)	1 (25)	0.11	1.01	4.92
Amount	6 (100)	4 (100)			

Based on Table 11, it shows that severe preeclampsia in both good and low lifestyles has a similarity value of 50%. In the mild preeclampsia group, 75% had a good lifestyle and only 25% had a low lifestyle. Shows that the significance value shows that the lifestyle factor physical activity does not significantly influence the incidence of preeclampsia ($0.201 > 0.05$). So an active lifestyle is not a risk factor for preeclampsia in pregnant women.

Multivariate Analysis of Biological Factors Affecting Preeclampsia

Table 12. Multivariate analysis of characteristics of factors influencing the incidence of preeclampsia

Category	B	p	OR	95%CI
Parity	3.339	0.031	3.029	5.120
IMT	1.502	0.018	9.120	4.198
Dietary habit	1.102	0.041	8.137	6.413
History of Complications	2.762	0.001	4.398	8.345
Activity Lifestyle	1.089	0.114	1.012	4.924

The results of the analysis in table 5.12 show that there is only 1 variable that has $p > 0.05$ and 4 variables that have a p value < 0.05 so the next stage of analysis was not carried out. So in this study the activity lifestyle factor was a factor that did not influence the incidence of preeclampsia.

Discussion

Univariate Analysis of Biological Factors Affecting Preeclampsia

The Incidence of Preeclampsia

Based on the research results, it shows that the incidence of preeclampsia in the Curug Community Health Center working area was 6 people (60%) with severe preeclampsia and 4 people (40%) with mild preeclampsia. This is in line with research conducted by Tschiderer et al. (2024). Based on research conducted at Ibnu Sina Hospital, West Pasaman, out of 55 respondents, there were 26 pregnant women with preeclampsia (47.3%) and 29 pregnant women without experiencing preeclampsia (52.7%). The cause of preeclampsia is not yet known, which is why preeclampsia is called a disease of theories. The pathogenesis of preeclampsia includes the phenomenon of denial, namely inadequate production of blocking antibodies, placental perfusion, changes in vascular reactivity, imbalance between prostacyclin and thromboxane, decreased glomerular filtration rate with salt and water retention, decreased intravascular volume, increased central nervous system irritability, spread of coagulation. intravascular (Disseminated Intravascular Coagulation, DIG), stretching of the uterine muscles (ischemia), dietary factors and genetic factors. From the theories previously explained, no one has been able to prove the actual pathogenesis process of preeclampsia (Venou et al., 2024).

Parity

Based on the research results, it shows that the parity factor in the Curug Health Center working area is 4 people (60%) for primigravidas and 6 people (60%) for multigravidas. Parity is a risk factor associated with the onset of preeclampsia. the frequency is higher in primigravidas, around 75% than in multigravidas. When compared with multiparas, the frequency of preeclampsia in nulliparas is higher, especially for young nulliparas. The effect of parity is large because almost 20% of nulliparas suffer from hypertension before, during delivery, or the postpartum period than multiparas, possibly due to exposure to chorialis villi for the first time. Parity is a risk factor associated with the onset of preeclampsia. In primigravidas, the frequency occurs approximately 75% more than in multigravidas (Tranidou et al., 2024).

This occurrence is in accordance with the theory which states that the more a mother experiences childbirth, the reproductive organs will weaken and lose their flexibility. Conditions of function and reproductive organs that are not optimal will cause the function of the endothelium to be disrupted due to decreased blood, oxygen and nutrients supplied to the placenta, causing the presence of toxic or sensitive substances to affect the endothelium. So the consequences of this process will make pregnant women who have often experienced childbirth increase their chances of experiencing complications during the next pregnancy, namely preeclampsia (Rybak-Krzyszowska et al., 2023).

Body Mass Index (BMI)

Based on the research results, it shows that the BMI factor in the Curug Community Health Center working area is in the normal category as many as 5 people (50%) and in the small category, underweight and over BMI is 1 person each (10%). The data shows a normal BMI (18.5-24.9), there is 1 respondent (2.4%) who experienced mild preeclampsia. According to Wafda (2019) in his book entitled *Midwifery Care in Complex Maternal and Neonatal Cases*, there are several specific risk factors that influence the occurrence of preeclampsia apart from body mass index, including familial factors, history of preeclampsia, primigravida, multiple pregnancies, and history of certain diseases.

Obesity is the accumulation of excessive fat in the body. Obesity is a nutritional problem due to excess calories, usually accompanied by excess fat and animal protein, excess sugar and salt which can later be a risk factor for various types of degenerative diseases, such as diabetes mellitus, hypertension, coronary heart disease, rheumatism and various types of malignancies (cancer). and other health problems. One way to identify overweight or obesity in adults is to use the Body Mass Index (BMI), which is categorized as obese if the BMI is ≥ 25 kg/m² for the Asia Pacific region.

Dietary Habit

Based on the research results, there are 7 people (70%) who have a good diet and 3 people (30%) who have a poor diet. Pregnant women with unhealthy habits or eating patterns can cause various problems both for themselves and their fetus. One of the problems if the mother's diet is unhealthy is preeclampsia. Apart from poor diet, another cause of preeclampsia in pregnant women is the age of the pregnant woman herself (Function et al., 2024).

Pregnant women are advised to consume balanced nutritious food every day. Staple foods, side dishes, vegetables, fruit and drinks are components of the five

food groups that pregnant women must consume every day. Maintaining a diet during pregnancy is aimed at preventing preeclampsia. Pregnant women who don't consume enough fruit, consume a lot of salt, often consume foods that contain fat, and often consume caffeine such as coffee can increase blood pressure which can trigger preeclampsia. Maintaining a good diet, namely reducing consumption of fatty foods, salt intake and increasing consumption of fruit and vegetables is a way to avoid preeclampsia (Afraie et al., 2023).

History of Complications

Based on the research results, it showed that 8 pregnant women (80%) had no history of complications and 2 people (20%) had a history of complications. Pregnant women who have a history of hypertension during their pregnancy can be detected before giving birth according to the 2nd 10 T standard that every pregnant woman who makes a pregnancy visit must have their blood pressure checked so that treatment can be done quickly and precisely and referrals can be made. as early as possible. However, the results of the research were that there were still mothers with a history of hypertension because it was found that 13 (81.2%) of the 16 mothers who gave birth with a history of hypertension were multiparous mothers with a history of hypertension. This is in accordance with the theory which states that one of the predisposing factors for chronic hypertension is multipara (Tschiderer et al., 2024).

According to Llurba et al. (2024), who stated that there is a relationship between a history of hypertension and the incidence of preeclampsia. Pregnant women with a history of hypertension will have a greater risk of experiencing superimposed preeclampsia. This is because hypertension suffered since before pregnancy has resulted in disruption/damage to the body's important organs and, with pregnancy, the body's work will become more difficult, resulting in edema and proteinuria. Preeclampsia occurs in pregnant women who have a history of hypertension, 21 times higher than in respondents who do not have a history of hypertension.

Activity Lifestyle

Based on the research results, there were 6 pregnant women with a good activity lifestyle (60%) and 4 people with a low activity lifestyle (40%). Many pregnant women do exercise to avoid complications during pregnancy or even delivery. That pregnant women who engage in physical activity during pregnancy provide health benefits for the mother and fetus. Modifying a healthy lifestyle for everyone is very important to maintain health and is an important part of treating

hypertension. All hypertensive patients must make lifestyle changes. Apart from lowering blood pressure in patients with hypertension, lifestyle modifications can also reduce the progression of blood pressure to hypertension in patients with prehypertension.

Psychological factors influence the physical condition of pregnant women's health, where emotional changes occur during pregnancy due to an increase in the hormones estrogen and progesterone which trigger pregnant women to become anxious, irritable and stressed which can result in impaired growth and development of the fetus. Physical activity in pregnant women can reduce the risk of complications related to hypertension so it is highly recommended during pregnancy. Pregnant women who do physical activity can reduce diastolic blood pressure by 3.5 mmHg and can reduce the risk of preeclampsia (Jayani & Listika, 2020).

Bivariate Analysis Related to Biological Factors that Influence Preeclampsia

Relationship between Parity and the Incidence of Preeclampsia

Parity is the number of pregnancies that produce live or dead fetuses, not the number of fetuses born (Bobak et al., 2018). Based on the results of the analysis, it is known that there are 3 people (50%) with severe preeclampsia and 3 people (50%) with severe preeclampsia and 1 person (25%) with parity factor for primigravida and 3 people with multigravida (75%). From the analysis test results in Table 7, the significance value shows that the parity factor significantly influences the incidence of preeclampsia ($0.031 < 0.05$). The magnitude of the influence of high-risk parity on the incidence of preeclampsia is 32 times. This shows that pregnant women with their first pregnancy and more than 3 pregnancies, whether still or live births, have the potential to experience preeclampsia.

The results of the chi-square test, a P-Value was obtained of $0.032 \leq \alpha 0.05$, meaning that there is a relationship between parity and the incidence of preeclampsia. So the hypothesis that states there is a relationship between parity and the incidence of preeclampsia is statistically proven. The Odds ratio results obtained an OR value of: 2.778, meaning that respondents in the high risk age category were 2.778 times more likely to experience preeclampsia compared to those in the low risk age category. In a similar study conducted the results of this study were that the majority of respondents were multipara, 77 respondents (55%) with the number of preeclampsia patients being 42 respondents (30%). There is a significant relationship between the parity of pregnant women and the incidence of preeclampsia at Ibunda Hospital, Bagan Sinembah District, Rokan Hilir Regency (p value = 0.000).

Another study explained that the results of the analysis carried out using the chi-square test found a p -value = 0.003, so H_0 was declared rejected because the p -value $< \alpha = 0.05$, which means there is a relationship between the parity factor and the incidence of preeclampsia in pregnant women in RSUD Pakuhaji, Tangerang Regency. This is also proven based on the OR values obtained from the results of the multivariate analysis carried out in the research, namely in the multipara category, they got OR = 1.846, and in the grandemultipara category, they got OR = 1.298, which means that pregnant women who have parity status in the multipara category have a risk of 1.8 times more likely to experience higher or severe preeclampsia than pregnant women with other parity status categories, whereas pregnant women who have parity status in the Grande multipara category are 1.3 times more likely to experience higher or severe preeclampsia than pregnant women with other parity status categories.

Relationship between BMI and the Incidence of Preeclampsia

Based on the results of the analysis of the relationship between Body Mass Index (BMI) and the incidence of preeclampsia in pregnant women, it was found that out of 10 pregnant women, 5 (50%) pregnant women with normal nutritional status experienced preeclampsia, and 3 (30%) pregnant women with normal nutritional status obesity leads to preeclampsia. It was found that 1 (10%) pregnant woman each with underweight and over nutritional status experienced preeclampsia. The statistical test results used Chi-Square p -value 0.018 (p -value < 0.05) so it can be concluded that there is a significant relationship between maternal nutritional status based on BMI and the incidence of preeclampsia in pregnant women.

Supported by research conducted the results of this research were that the majority of Body Mass Index (BMI) were in the fat category, 42 people (40%). The incidence of preeclampsia was 30 people (28.6%). The results of data analysis using the Chi-Square formula obtained a p -value of 0.041 (p -value < 0.05) so it can be concluded that there is a significant relationship between maternal nutritional status based on BMI and the incidence of preeclampsia in pregnant women. As well as research conducted, based on the results of the analysis of the relationship between body mass index and the incidence of preeclampsia, it shows that of the 105 respondents who experienced preeclampsia, 13 (12.4%) people suffered from body mass index with normal weight. preeclampsia, 51 (48.6%) respondents suffering from preeclampsia had an overweight body mass index, meanwhile, 41 (39%) respondents suffering from preeclampsia had an obese body mass index. From the results of statistical tests, the p value was obtained,

namely $0.002 < 0.05$. The conclusion obtained is that there is a relationship between body mass index and the incidence of preeclampsia at the Muhammadiyah Hospital in Surabaya.

Relationship between Eating Patterns and the Incidence of Preeclampsia

Based on the results of the analysis of the relationship between eating patterns and the incidence of preeclampsia in pregnant women, it was found that out of 10 pregnant women, it was found that 2 (33.3%) pregnant women with good eating patterns experienced severe preeclampsia and 4 pregnant women (66.7%) had poor eating patterns and in mild preeclampsia with a good diet, there was 1 pregnant woman (25%) and 3 pregnant women (75%) with a poor diet. The statistical test results used Chi-Square p-value 0.041 (p-value < 0.05) so it can be concluded that there is a significant relationship between the diet of pregnant women and the incidence of preeclampsia in pregnant women.

This is supported by research conducted by (Tranidou et al., 2024). Respondents with a good diet were more likely to not experience preeclampsia as many as 34 (94.4%) respondents, while respondents with a good diet were more likely to not experience preeclampsia as many as 30 (100%) respondents, while respondents with a more or less healthy diet were more likely to suffer from preeclampsia. 13 (68.4%) respondents experienced preeclampsia. Based on statistical tests using the Chi-square test with a confidence level (α) of 95% (0.05), a p-value was found (0.000). This means the p-value $< \alpha$, so it can be concluded that ($0.000 < 0.05$) which means there is a relationship between diet and the incidence of preeclampsia in pregnant women at Kuala Pembuang Regional Hospital, Seruyan Hilir District, Seruyan Regency in 2021.

And in research conducted by Wulandari et al. (2022), univariate analysis explained that of the 32 respondents, 20 (62.5%) had poor diets, and 12 (37.5%) others had good diets. Bivariate analysis showed that of the 32 samples, there were 20 mothers with poor eating patterns, 14 respondents (70%) with preeclampsia and 6 respondents (30%) without good eating patterns. And of the 12 respondents with good eating patterns, only 2 (16.7%) experienced preeclampsia and 10 (83.3%) did not experience preeclampsia. P-Value = 0.011, meaning that there was a significant relationship between diet and preeclampsia in TM III pregnant women. OR = 11.667, meaning that respondents with poor eating patterns are 11.667 times more likely to experience preeclampsia.

Researchers assume that diet plays a major role in preeclampsia. Pregnant women who have a poor diet can increase blood pressure which can trigger

preeclampsia. Poor eating patterns that can trigger preeclampsia include not consuming enough vegetables and fruit, frequent consumption of salty and fatty foods and high consumption of caffeine. Therefore, pregnant women are advised to maintain their diet during pregnancy to avoid preeclampsia (Knorr et al., 2024).

Relationship between History of Complications and Incidence of Preeclampsia

Based on the results of the analysis of the relationship between history of complications and the incidence of preeclampsia in pregnant women, it was found that out of 10 pregnant women, 5 (83.3%) pregnant women with a history of complications experienced severe preeclampsia and 1 (16.7%) of those without a history of complications. Meanwhile, of pregnant women with mild preeclampsia, there were 3 (75%) who had a history of complications and 1 (25%) who did not have a history of complications. The statistical test results use a Chi-Square p-value of 0.001 (p-value < 0.05) so it can be concluded that there is a significant relationship between the history of complications in pregnant women and the incidence of preeclampsia in pregnant women.

This is supported by research conducted by Mariati et al. (2022), showing that in the case group whose history of hypertension was at risk and experienced preeclampsia, there were 105 respondents or around 70.47%, in the control group it showed that 13 (29, 53%) of respondents had a history of hypertension which was not at risk and experienced preeclampsia. The statistical test results obtained a p value of 0.0001. Researchers assume that those who have a history of hypertension in a previous pregnancy will cause recurrent hypertension in subsequent pregnancies. This is because the history of the mother's illness is a determinant of the occurrence of complications in subsequent pregnancies.

Another study by Huang et al. (2024) found that 58.8% of respondents with a previous history of preeclampsia had a history of preeclampsia, 47.1% of respondents with a previous history of preeclampsia had no history of preeclampsia, 47.1% of respondents with a previous history of preeclampsia had no history of preeclampsia. The Chi Square test results show a p value of $0.364 > 0.05$, with these results it can be concluded that the hypothesis is rejected, namely that there is no relationship between a previous history of preeclampsia and the incidence of preeclampsia.

Relationship between Lifestyle Activities and the Incidence of Preeclampsia

Based on the results of the analysis of the relationship between activity lifestyle and the incidence of preeclampsia in pregnant women, it was found that

out of 10 pregnant women, 3 (50%) pregnant women with a good activity lifestyle experienced severe preeclampsia and 3 (50%) with a low activity lifestyle. Meanwhile, of pregnant women with mild preeclampsia, there were 3 (75%) who had a good activity lifestyle and 1 (25%) who had a low activity lifestyle. The statistical test results used Chi-Square p-value 0.114 ($p\text{-value} < 0.05$) so it can be concluded that there is no significant relationship between the activity lifestyle of pregnant women and the incidence of preeclampsia in pregnant women.

In another study by Chen et al. (2024), based on the results of the Spearman rank test between Lifestyle variables and the incidence of preeclampsia in pregnant women at the Turi Community Health Center, Lamongan Regency, the p value = 0.000 was obtained, where the p value $< \alpha$ 0.05. So H_1 is accepted, which means there is a relationship between lifestyle and the incidence of preeclampsia in pregnant women at the Turi Community Health Center, Lamongan Regency. Lifestyle is a reflection of every person who wears it and describes how much someone behaves in society. Apart from that, lifestyle can also be interpreted as an art that is cultivated by everyone. Modifying a healthy lifestyle for everyone is very important to maintain health and is an important part of treating hypertension. All hypertensive patients must make lifestyle changes. Apart from lowering blood pressure in patients with hypertension, lifestyle modifications can also reduce the progression of blood pressure to hypertension in patients with prehypertension.

Multivariate Analysis of Biological Factors Affecting Preeclampsia

Based on the results of the final modeling multivariate analysis, the factors that had a statistically significant effect on the incidence of preeclampsia in pregnant women at the Curug Community Health Center were history of complications, BMI, parity and eating patterns. There is a history of complications P-Value This 0.001 shows a significant relationship with the incidence of preeclampsia with an OR value of 4.398, which means that mothers who have a history of complications have a 4.398 times risk of experiencing preeclampsia compared to mothers who have no history of complications, after controlling for other variables. Furthermore, the BMI variable is the most dominant variable influencing the incidence of preeclampsia with an OR = 9.120. This can be interpreted to mean that the abnormal BMI factor has a risk of experiencing preeclampsia 9.120 times greater than the normal BMI factor after being controlled by the variables history of complications, parity and diet. Meanwhile, factors that are not included in the model ($p\text{-value} > 0.25$) is an

activity lifestyle variable that has a value $p\text{-value}$ 0.114 (> 0.05), so it was also concluded that the activity lifestyle variable had no effect on the incidence of preeclampsia.

Conclusion

Based on the research results, it can be concluded that there are certain biological factors that are associated with the incidence of preeclampsia in pregnant women at the Curug Community Health Center. This research shows that there is a significant relationship between parity and the incidence of preeclampsia, with a $p\text{-value}$ of 0.031 (< 0.05). Apart from that, there is a significant relationship between body mass index (BMI) and the incidence of preeclampsia, with a $p\text{-value}$ of 0.018 (< 0.05). Diet also shows a significant relationship with the incidence of preeclampsia, with a $p\text{-value}$ of 0.041 (< 0.05). Furthermore, a history of complications has a very significant relationship with the incidence of preeclampsia at the Curug Community Health Center, with a $p\text{-value}$ of 0.001 (< 0.05). However, this study did not find a significant relationship between lifestyle activities and the incidence of preeclampsia, with a $p\text{-value}$ of 0.114 (> 0.05). The results of this study emphasize the importance of monitoring and intervening with certain biological factors to reduce the risk of preeclampsia in pregnant women.

Acknowledgments

We would like to express our deepest gratitude to our advisor who has guided us throughout the research process and to the respondents who have made significant contributions to the success of this study. Your support, guidance, and participation have been invaluable, and we greatly appreciate your effort and dedication. Thank you for your continuous encouragement and for making this research possible.

Author Contributions

N.Y., S.J., I.D., I.Y., and I.S.D. contributed to the conceptualization, data collection process, data processing, and article writing.

Funding

This research was funded by personal funds.

Conflicts of Interest

The authors declare no conflict of interest.

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