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Determinants of Severe Preeclampsia in Mothers Giving Birth at dr. Dradjat Prawiranegara Hospital in Serang Regency Indonesia

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ABSTRACT

Preeclampsia is a condition where a pregnant woman's blood pressure increases accompanied by the presence of protein in the urine. Conditions like this are triggered by the fetus' placenta not functioning or developing properly. Preeclampsia/eclampsia is the second cause after bleeding as a direct cause of maternal death. The aim of the research was to analyze the determinants of the incidence of severe preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara Serang 2023. This research is an analytical correlative research with a retrospective design. The samples taken used purposive sampling technique, namely 69 mothers who experienced preeclampsia. The results of this study showed that there were mothers giving birth with an incidence of PEB of 69%, there was a relationship between BMI and PEB (p-value 0.000 and OR 5.060), there is a relationship between a history of preeclampsia and PEB (p-value 0.000 and OR 9.608), there is a relationship between weight gain during pregnancy and PEB (p-value 0.036 and OR 4,083), there is a relationship between a history of DM and PEB (p-value 0.033 and OR 2,797), and there is a relationship between a history of consuming high doses of calcium and PEB (p-value 0.000 and OR 6.632). The most influential determinant of the incidence of PEB is a history of preeclampsia (p-value 0.005 and OR 7.351).The conclusion of this study is that there is a relationship between BMI, history of preeclampsia, body weight during pregnancy, history of DM and history of consuming high doses of calcium with the incidence of severe preeclampsia, It is hoped that Dr. Drajat Prawiranegara to be able to maintain service quality, especially in providing comprehensive midwifery care.

Introduction

Pregnancy is a physiological process, but numerous complications can lead to high maternal mortality, one of which is preeclampsia. Approximately 13% of women aged 15–20 years are at high risk for both the mother and the fetus. Women aged 35 years show a significant increase in the incidence of hypertension or preeclampsia. Maternal mortality rates are higher in women with extreme ages, particularly 35 years and older. Additionally, 85% of preeclampsia cases occur in primigravida. Parity of 2–3 is considered the safest in terms of preeclampsia occurrence, while the risk increases again in grand multipara women (Erlita, 2017). Pregnant women over the age of 35 experience physiological changes such as vasospasm, excessive activation of the coagulation system, and hormonal disorders. These changes lead to a reduction in prostacyclin production, a strong vasodilator. Furthermore, platelet aggregation occurs in damaged endothelial cells, resulting in excessive production of the vasoconstrictor thromboxane.

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The thromboxane levels are significantly higher than prostacyclin levels, leading to continuous vasoconstriction and increased blood pressure (Martadiansyah, 2019).

Hypertension during pregnancy is a major health issue contributing to high maternal mortality and morbidity rates. The prevalence of hypertension in pregnancy ranges from 5–15% and is one of the three leading causes of maternal mortality and morbidity during childbirth, alongside infection and hemorrhage. If chronic hypertension is not well managed, pregnant women may develop preeclampsia (Leveno, 2018). Some direct causes of maternal death include hypertensive disorders in pregnancy (31.90%), obstetric hemorrhage (26.90%), non-obstetric complications (18.5%), other obstetric complications (11.80%), pregnancy-related infections (4.20%), abortion (5%), and other causes (1.70%) (Kesga, 2022). Hypertensive disorders in pregnancy are one of the leading causes of maternal and perinatal mortality worldwide, with preeclampsia complicating an estimated 2–8% of pregnancies globally (Practice Bulletin, 2020).

The global maternal mortality rate in 2020 was 223 per 100,000 live births (WHO, 2023). Nearly 800 women died due to preventable pregnancy and childbirth-related causes (WHO, 2023). In Indonesia, the maternal mortality rate remains around 305 per 100,000 live births, still falling short of the 2024 target of 183 per 100,000 live births (Ministry of Health, 2023).

According to the 2018 Sampling Registration System (SRS) data, about 76% of maternal deaths occurred during childbirth and the postpartum period, with 24% occurring during pregnancy, 36% during childbirth, and 40% postpartum. The high maternal mortality rate is caused by various risk factors that arise before pregnancy, such as anemia, malnutrition, obesity, and pre-existing conditions like tuberculosis. During pregnancy, complications such as hypertension, hemorrhage, anemia, diabetes, infections, and heart disease further contribute to maternal mortality (Ministry of Health, 2021).

Banten Province is one of the areas with the highest number of maternal and infant deaths in Indonesia. The position of maternal and infant mortality rates in Banten Province is always considered high. Serang Regency is a red zone area and is a priority in efforts to overcome maternal and infant mortality. This is evidenced by the involvement of Serang Regency in several Central Government programs as an effort to overcome maternal and infant mortality (Kartikasari et al., 2025).

Based on data from the Serang District Health Office in 2021, most maternal and neonatal deaths occurred around childbirth, often due to deliveries attended by unqualified healthcare providers. The coverage of skilled birth attendants (Linakes) in Serang Regency in 2021 reached 94.9% of the target 32,924 pregnant women. Efforts have been made to increase Linakes coverage, as the primary causes of maternal death remain hypertension in pregnancy (23 cases), hemorrhage (15 cases), circulatory system disorders (6 cases), and other causes (33 cases).

Maternal mortality refers to the number of women who die during pregnancy, childbirth, or within 40 days postpartum. Several factors influence maternal mortality, including education level, socioeconomic status, awareness of clean and healthy living behaviors, nutritional and health status, environmental health conditions, and the quality of healthcare services. Among 31,973 live births, 77 maternal deaths were recorded: 25 during pregnancy, 15 during childbirth, and 37 during the postpartum period. The persistence of maternal deaths indicates that healthcare services remain suboptimal, and the quality of delivery assistance still does not meet the required standards. The maternal mortality rate in Serang District was recorded at 241 per 100,000 live births (Serang District Health Office, 2022).

Hypertension in pregnancy is defined as a condition where blood pressure is ≥140/90 mmHg. Hypertensive disorders in pregnancy include gestational hypertension, preeclampsia, and

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eclampsia. Preeclampsia is a more severe form of hypertension than gestational hypertension and is classified into two types: mild and severe preeclampsia, based on systolic and diastolic blood pressure levels (Ministry of Health, 2021). Preeclampsia is a condition in which a pregnant woman's blood pressure increases along with the presence of protein in the urine. This condition is triggered by a malfunctioning or poorly developed placenta. Preeclampsia and eclampsia are the second leading direct causes of maternal mortality after hemorrhage. The diagnosis of preeclampsia is based on pregnancy-induced hypertension with multiple organ system involvement after 20 weeks of gestation (Directorate General of Health Services, 2023).

A study by Pangesti (2022) found that the most common risk factors for preeclampsia in Banyumas Regency were multiparity (74.3%), maternal age >35 years (14.2%), BMI ≥ 30 kg/m^2 (9.9%), and a history of hypertension (1.9%). Evi (2022) concluded that the factors influencing preeclampsia occurrence include a history of preeclampsia/eclampsia and calcium intake as a preventive factor. It is recommended that pregnant women at risk for preeclampsia consume calcium at a recommended dose of 1.5–2 g/day. Lesi (2020) found that factors associated with preeclampsia in mothers giving birth include antenatal care (ANC) visits with a P-value of 0.00, OR 7.271, R^2 15.5%, and a history of hypertension with a P-value of 0.000, OR 37.665, R^2 30.1%.

A preliminary study conducted at Dr. Dradjat Prawiranegara Regional Hospital, Serang, from January to August 2023 recorded 3,279 childbirths, with 507 cases of severe preeclampsia, accounting for 15.46% of deliveries. Given the crucial role of healthcare workers in reducing maternal mortality and the current situation where hypertensive disorders in pregnancy, particularly severe preeclampsia, are the leading causes of maternal deaths in Serang District, this study aims to further explore the risk factors for severe preeclampsia and the role of calcium intake as a preventive factor in line with WHO recommendations. The aim of this study is to analyze the determinants of severe preeclampsia in mothers giving birth at Dr. Dradjat Prawiranegara Regional Hospital, Serang, in 2023.

Methods

This study is an analytical correlational study. In this study, the researcher analyzes the relationship between factor variables and the incidence of PEB. The research design used is retrospective. Secondary data collection in this study was conducted by accessing the medical records of mothers who experienced severe preeclampsia at the hospital (RSUD) within a specific time period. The collected data included preeclampsia incidence, history of preeclampsia, body mass index, weight gain during pregnancy, history of diabetes mellitus, and history of high-dose calcium consumption. Once the data were gathered, a sorting process was carried out to ensure completeness and compliance with the inclusion and exclusion criteria. The collected data were then analyzed using the chi-square test to examine the relationship between risk factors and the occurrence of severe preeclampsia. The results of this analysis serve as a basis for determining the key determinant factors contributing to severe preeclampsia in mothers giving birth at the hospital. The population in this study consists of all mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital. The sampling method used is the purposive sampling technique, involving a total of 69 respondents.The inclusion criteria in this study are mothers with preeclampsia and mothers who give birth at RSUD Dr. Dradjat Prawiranegara. Meanwhile, the exclusion criteria in this study are mothers who do not consent to be respondents and not have complete data. The study was conducted at Dr. Drajat Prawiranegara Regional Hospital from November to December 2023. The research instrument use secondary data from medical records

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at Dr. Dradjat Prawiranegara Hospital. The results of this study were analyzed using the chi-square test.

Results

Table 1. Frequency Distribution of Preeclampsia Incidence, BMI, History of Preeclampsia, Weight Gain During Pregnancy, History of Diabetes Mellitus, and High-Dose Calcium Intake at Dr. Drajat Prawiranegara Regional Hospital in 2023

Variable	N	%
Preeclampsia Incidence		
Severe Preeclampsia (PER)	69	69
Mild Preeclampsia (PEB)	31	31
BMI		
Obese	29	29
Overweight	23	23
Normal	31	31
Underweight	17	17
History of Preeclampsia		
Yes	38	38
No	62	62
Weight Gain During Pregnancy		
Excessive	23	23
Appropriate	53	53
Insufficient	24	24
History od Diabetes Melitus		
Yes	24	24
No	76	76
High-Dose Calcium Intake		
No	82	82
Yes	18	18

Based ĺon the table above, it can be seen that the majority of respondents in this study experienced Severe Preeclampsia (PEB), with a total of 69 respondents (69%). Meanwhile, a smaller proportion of respondents experienced Mild Preeclampsia (PER), totaling 31 respondents (31%). A small portion of the respondents had a normal Body Mass Index (BMI), amounting to 31 respondents (31%), whereas only a very small number of respondents had a low BMI, with just 17 respondents (17%). The majority of respondents did not have a history of preeclampsia, with 62 respondents (62%), while a smaller proportion, 38 respondents (38%), had a history of preeclampsia. Nearly half of the respondents in this study experienced appropriate weight gain during pregnancy, with 53 respondents (53%). Most respondents in this study did not have a history of diabetes mellitus (DM), totaling 76 respondents (76%), whereas a very small proportion, 24 respondents (24%), had a history of DM. Almost all respondents in this study did not consume high-dose calcium, totaling 82 respondents (82%), while a very small proportion, 18 respondents (18%), consumed high-dose calcium.

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Table 3. The Relationship Between Body Mass Index, History of Preeclampsia, Weight Gain During Pregnancy, History of Diabetes Mellitus, and High-Dose Calcium Intake with the Incidence of Preeclampsia in Mothers Giving Birth at Dr. Drajat Prawiranegara Regional Hospital, Serang, in 2023

Variabel	Severe Preeclampsia (PER)		Mild Preeclampsia (PEB)		Total		P- value	OR
	f	%	*f*	%	*f*	%		
BMI								
Obese	28	96,6	1	3,4	29	100		
Overweight	16	69,6	7	30,4	23	100	0,000	5,060
Normal	21	67,7	10	32,3	31	100		
Underweight	4	23,5	13	17	76,5	100		
History of Preeclampsia								
Yes	35	92,1	3	7,9	38	100	0,000	9,608
No	34	54,8	28	45,2	62	100		
Weight Gain During Pregnancy								
Excessive	21	87,5	3	12,5	24	100		
Appropriate	37	67,3	18	32,7	55	100	0,036	4,083
Insufficient	11	52,4	10	47,6	21	100		
History od Diabetes Melitus								
Yes	31	81,6	7	18,4	38	100	0,033	2,797
No	38	61,3	24	38,7	62	100		
High-Dose Calcium Intake								
No	63	76,8	19	23,2	82	100	0,000	6,632
Yes	6	33,3	12	66,7	18	100		
Total	69	69	31	31	100	100		

The relationship between Body Mass Index (BMI) and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital.

Based on the table, among mothers with severe preeclampsia, 23.5% (4 individuals) had a low BMI, 67.7% (21 individuals) had a normal BMI, 69.6% (16 individuals) were overweight, and 96.6% (28 individuals) were obese. Meanwhile, among mothers with mild preeclampsia, 17% (13 individuals) had a low BMI, 32.3% (11 individuals) had a normal BMI, 30.4% (7 individuals) were overweight, and 3.4% (1 individual) was obese.

The Chi-Square test examining the relationship between BMI and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital showed a significance value (p-value) of 0.000. The statistical test results indicate that p-value = 0.000 is smaller than the threshold p-value of 0.05, meaning there is a significant relationship between BMI and the incidence of preeclampsia in mothers giving birth.

With an odds ratio of 5.060, this means that mothers with excessive BMI or obesity have 5.060 times the risk of developing preeclampsia.

The data on the relationship between a history of preeclampsia and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital presents the following findings: Among mothers with severe preeclampsia, 92.1% (35 individuals) had a history of preeclampsia, while 54.8% (34 individuals) had no history of preeclampsia. Meanwhile,

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among mothers with mild preeclampsia, 7.9% (3 individuals) had a history of preeclampsia, while 45.2% (28 individuals) had no history of preeclampsia.

The Chi-Square test on the relationship between a history of preeclampsia and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital resulted in a significance value (p-value) of 0.000. The statistical test results indicate that p-value = 0.000 is smaller than the threshold p-value of 0.05, meaning there is a significant relationship between a history of preeclampsia and the incidence of preeclampsia in mothers giving birth. With an odds ratio of 9.608, this means that mothers who have a history of preeclampsia are 9.608 times more likely to develop preeclampsia.

The data on the relationship between weight gain during pregnancy and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital presents the following findings among mothers with severe preeclampsia 87.5% (21 individuals) experienced excessive weight gain during pregnancy, 67.3% (37 individuals) had appropriate weight gain during pregnancy, 52.4% (11 individuals) had insufficient weight gain during pregnancy. Meanwhile, among mothers with mild preeclampsia 12.5% (3 individuals) experienced excessive weight gain during pregnancy, 32.7% (18 individuals) had appropriate weight gain during pregnancy, 47.6% (10 individuals) had insufficient weight gain during pregnancy.

The Chi-Square test on the relationship between weight gain during pregnancy and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital resulted in a significance value (p-value) of 0.036. The statistical test results indicate that p-value = 0.036 is greater than the threshold p-value of 0.05, meaning that weight gain during pregnancy has a relationship with the incidence of preeclampsia in mothers giving birth. With an odds ratio of 4.083, this means that excessive weight gain during pregnancy increases the risk of developing preeclampsia by 4.083 times.

The data on the relationship between a history of diabetes mellitus (DM) and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital presents the following findings : Among mothers with severe preeclampsia 81.6% (31 individuals) had a history of DM, 61.3% (38 individuals) had no history of DM. Meanwhile, among mothers with mild preeclampsia 18.4% (7 individuals) had a history of DM, 38.7% (24 individuals) had no history of DM.

The Chi-Square test on the relationship between a history of DM and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital resulted in a significance value (p-value) of 0.033. The statistical test results indicate that p-value = 0.033 is less than the threshold p-value of 0.05 (0.033 < 0.05), meaning that a history of DM is significantly associated with the incidence of preeclampsia in mothers giving birth. With an odds ratio of 2.797, this means that mothers with a history of DM have a 2.797 times higher risk of developing preeclampsia.

The data on the relationship between high-dose calcium intake and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital presents the following findings: Among mothers with severe preeclampsia 76.8% (63 individuals) did not consume high-dose calcium, 33.3% (6 individuals) consumed high-dose calcium. Meanwhile, among mothers with mild preeclampsia 23.2% (19 individuals) did not consume high-dose calcium, 66.7% (12 individuals) consumed high-dose calcium.

The Chi-Square test on the relationship between high-dose calcium intake and the incidence of preeclampsia in mothers giving birth at Dr. Drajat Prawiranegara Regional Hospital resulted in a significance value (p-value) of 0.000. The statistical test results indicate that p-value

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= 0.000 is less than the threshold p-value of 0.05 (0.000 < 0.05), meaning that there is a significant relationship between high-dose calcium intake and the incidence of preeclampsia in mothers giving birth. With an odds ratio of 6.632, this means that mothers who do not consume high-dose calcium have a 6.632 times higher risk of developing preeclampsia.

Table 4. The Most Influential Determinants of Severe Preeclampsia in Mothers Giving Birth at Dr. Drajat Prawiranegara Regional Hospital, Serang, in 2023

Variable	*p value*	OR (95% CI)
Body Mass Index	0,068	3,527 (0,909-13,681)
History of Preeclampsia	0,005	7,351 (1,813-29,807)
Weight Gain During Pregnancy	0,871	1,158 (0,198-6,765)
History od Diabetes Melitus	0,002	1,104 (0,321-3,799)
High-Dose Calcium Intake	0,004	6,492 (1,801-23,397)

Based on the multivariate analysis test, the table above indicates that the factors significantly associated with the incidence of severe preeclampsia at Dr. Drajat Prawiranegara Regional Hospital in 2023 include body mass index (BMI), history of preeclampsia, and history of high-dose calcium intake. Among these factors, history of preeclampsia is the most dominant variable associated with the occurrence of severe preeclampsia.

Discussion

Relationship Between BMI and the Incidence of Preeclampsia in Mothers Giving Birth

Based on the results of the Chi-Square test, the significance value (p-value) was 0.000, indicating a relationship between Body Mass Index (BMI) and the incidence of preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara. With an odds ratio of 5.060, it means that mothers with excessive BMI or obesity are 5.060 times more at risk of developing preeclampsia.

Excess body weight is one of the risk factors that increase the likelihood of preeclampsia, and this risk rises along with the increase in BMI. Obesity is significantly associated with insulin resistance and is a contributing risk factor for preeclampsia. Pregnant women with obesity may experience preeclampsia through various mechanisms, including hyperleptinemia, metabolic syndrome, inflammatory responses, increased oxidative stress through cytokines, and the direct hemodynamic effects of hyperinsulinemia. These factors can lead to endothelial damage and dysfunction, increased sympathetic activity, and enhanced tubular sodium reabsorption, ultimately leading to preeclampsia (POGI, 2016).

Obesity or overweight conditions are caused by multiple factors, including hereditary or genetic factors, metabolic disorders, and excessive food consumption. When an individual is overweight, the heart has to work harder, especially since obese individuals tend to experience blood vessel blockages due to fat plaque buildup. This condition increases the risk of preeclampsia. A study conducted by Nursal (2017) found that overweight or obese pregnant women had an odds ratio (OR) of 4.060, meaning that obese pregnant women were 4.060 times more at risk of developing preeclampsia compared to non-obese pregnant women (Nursal et al., 2017).

This study is consistent with research by Azizah, Ruliati, and Majidah (2020), where the Chi-Square test results showed a significance value (p-value) of 0.01, which is p < 0.05. This means

PROFESIONAL HEALTH JOURNAL
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that H1 is accepted, confirming a relationship between BMI in pregnant women and the incidence of preeclampsia. Pregnant women with excessive weight gain are at a higher risk of pregnancy and childbirth complications, including gestational hypertension, gestational diabetes, macrosomic babies, and cesarean deliveries.

This finding is supported by previous research by Susanti (2021), where the Lambda statistical test showed a p-value of 0.003 ($p < 0.05$), concluding a significant relationship between BMI and the incidence of preeclampsia at Klinik Pratama Ummi Talango. This study emphasizes the importance of weight monitoring before or during early pregnancy to adjust maternal and fetal nutrition accordingly and minimize complications such as preeclampsia.

A similar conclusion was reached by Nulanda (2019), whose study using the Spearman Rho statistical test found a p-value of 0.000 ($p < 0.05$), confirming a relationship between BMI and the risk of preeclampsia at RSI Sitti Khadijah 1 Makassar. Another study by Ravindra (2019) also found a significant relationship between BMI and preeclampsia, with a p-value of 0.01 ($p < 0.05$), further supporting the acceptance of H1.

Therefore, pregnant women should maintain a healthy diet and consume nutritious foods to regulate their BMI according to their needs. The habit of consuming high-fat and high-salt foods, along with an unbalanced diet, can lead to oxidative stress and increase the risk of preeclampsia during pregnancy (Insani & Supriatun, 2020).

According to the researcher's assumption, excess weight is one of the risk factors that increase the likelihood of preeclampsia, and this risk becomes higher as BMI increases. When an individual is overweight, the heart has to work harder, and obese individuals tend to experience blood vessel blockages due to fat plaque buildup, thereby increasing the risk of preeclampsia. The results of the Chi-Square test showed a significance value (p-value) of 0.000, indicating a relationship between BMI and preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara. With an odds ratio of 5.060, mothers with excessive BMI or obesity are 5.060 times more at risk of developing preeclampsia.

Relationship Between a History of Preeclampsia and the Incidence of Preeclampsia in Mothers Giving Birth

Based on the results of the Chi-Square test, the significance value (p-value) was 0.000, indicating a relationship between a history of preeclampsia and the incidence of preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara. With an odds ratio of 9.608, it means that mothers who have had preeclampsia in previous pregnancies are 9.608 times more at risk of experiencing preeclampsia again.

A history of preeclampsia in a previous pregnancy is a major risk factor. Pregnant women with a history of preeclampsia are more likely to experience severe preeclampsia, early-onset preeclampsia, and poor perinatal outcomes (Kemenkes, 2017). Theoretically, it is stated that women with a history of preeclampsia in previous pregnancies have an increased risk of developing preeclampsia in their current pregnancy compared to women who have never had preeclampsia (Von Dadelszen et al., 2016). A study by Tahir & Daswati (2017) also found a significant relationship between a history of preeclampsia and the risk of developing preeclampsia in subsequent pregnancies.

This finding aligns with the theory that mothers with a past medical history of preeclampsia are at risk of experiencing the condition again. Chronic hypertension-related preeclampsia occurs in pregnant women who already had hypertension before pregnancy (Gustri et al., 2016). This study is consistent with research by Sukmawati (2018), which examined 96 respondents. Among

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them, 29 respondents had a history of hypertension, leading to preeclampsia in 7 (14.3%) cases. Meanwhile, in the control group, 22 (22.4%) respondents had hypertension, showing a relationship between a history of hypertension and the incidence of preeclampsia.

Women with a history of preeclampsia have a higher tendency to experience it again due to the cardiovascular system's inability to fully recover from the condition. Those with recurrent preeclampsia tend to have worse cardiovascular health compared to women who have had normal pregnancies. They may exhibit increased carotid artery intima-media thickness, cardiac output, and left ventricular mass compared to pregnant women without preeclampsia (Thilaganathan & Kalafat, 2019).

According to the researcher's assumption, a history of preeclampsia is a significant factor in the occurrence of preeclampsia. Previous preeclampsia may have already caused damage to vital organs, and during pregnancy, the body's workload increases, leading to more severe complications such as edema and proteinuria. The Chi-Square test results showed a significance value (p-value) of 0.000, confirming a relationship between a history of preeclampsia and the incidence of preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara.

The Relationship Between Weight Gain During Pregnancy and the Incidence of Preeclampsia in Mothers Giving Birth

Based on the results of the Chi-Square test, the significance value (p-value) was 0.036, indicating a relationship between weight gain during pregnancy and the incidence of preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara. With an odds ratio of 4.083, it means that excessive weight gain increases the risk of developing preeclampsia by 4.083 times.

Obesity can trigger preeclampsia through several mechanisms, either via superimposed preeclampsia or through metabolic and micro-molecular triggers. The risk of preeclampsia increases approximately twofold with every 5-7 kg weight gain (Dewie et al., 2020). Several risk factors contribute to excessive weight gain, including genetic predisposition, low socioeconomic status, low physical activity, slow metabolism, childhood obesity, large birth weight, and dietary habits. Pregnancy and its effects naturally lead to weight gain in expectant mothers. In some cases, women may gain up to 50 kg during pregnancy. Obesity is associated with various health conditions such as hypertension, diabetes, gallbladder disease, and metabolic syndrome (Hastuti, 2019).

Uncontrolled or excessive weight gain in pregnant women can lead to high-risk pregnancy complications, including gestational diabetes, preeclampsia, post-term pregnancy, emergency cesarean section, elective cesarean section, postpartum hemorrhage, pelvic infections, urinary tract infections, wound infections, macrosomia, and stillbirth (Cunningham, 2016).

According to a study by Pratamaningtyas et al. (2019), titled *"The Relationship Between Weight Gain During Pregnancy at RSUD Gambiran, Kediri, in 2018,"* 89% of pregnant women with preeclampsia experienced abnormal weight gain, and 57.1% developed preeclampsia. The results of the Chi-Square test yielded a p-value of 0.022, confirming a significant relationship between weight gain during pregnancy and the incidence of preeclampsia at RSUD Gambiran, Kediri.

This finding aligns with a study by Sutiati Bardja (2020), which found that preeclampsia risk factors included age, parity, education, history of hypertension, family history, weight gain, number of fetuses, and calcium intake. These factors were significantly associated with the incidence of severe preeclampsia among pregnant women in the maternity ward of RSUD Arjawinangun, Cirebon, in 2019. Similarly, research by Rohmah (2019) identified several factors

PROFESIONAL HEALTH JOURNAL
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associated with severe preeclampsia in pregnant women in their third trimester, including age, parity, occupation, education, history of hypertension, and obesity. Statistical analysis revealed a p-value of 0.009, confirming a relationship between obesity and severe preeclampsia, with an odds ratio of 1.833, meaning obese women were 1.833 times more likely to develop severe preeclampsia than non-obese women.

Weighing before pregnancy is crucial for maintaining maternal and fetal health. If a woman is overweight before pregnancy, the recommended weight gain during pregnancy should be lower compared to women with an ideal weight. Pregnant women who experience excessive weight gain are at higher risk of pregnancy complications, including preeclampsia (Sunarto, 2016). According to the researcher's assumption, uncontrolled or excessive weight gain in pregnant women can lead to various pregnancy risks, including gestational diabetes, preeclampsia, post-term pregnancy, emergency and elective cesarean sections, postpartum hemorrhage, pelvic infections, urinary tract infections, wound infections, macrosomia, and stillbirth. If a woman is overweight before pregnancy, weight gain should be maintained within the recommended limits to prevent complications.

The Relationship Between a History of Diabetes Mellitus and the Incidence of Preeclampsia in Mothers Giving Birth

Based on the results of the Chi-Square test, the significance value (p-value) was 0.033, indicating a relationship between a history of diabetes mellitus (DM) and the incidence of preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara. With an odds ratio of 2.797, mothers with a history of DM are 2.797 times more likely to experience preeclampsia.

Diabetes mellitus is a metabolic disease characterized by high blood glucose levels (hyperglycemia) caused by impaired insulin secretion, insulin action, or both. Pregnant women with DM have a 1.35 times higher risk of developing severe preeclampsia compared to those without a history of DM. The occurrence of preeclampsia in diabetic mothers is often accompanied by kidney or vascular complications rather than being pure preeclampsia (Zahra, 2020).

This finding is consistent with research by Nurhayati (2021), which found a relationship between a history of DM and preeclampsia in mothers giving birth. The analysis showed an odds ratio (OR) of 4.5, meaning that mothers with DM have a 4.5 times higher likelihood of developing preeclampsia than those without DM. Similarly, Sri Ayu Rezeki (2021) in her study *"The Relationship Between Diabetes Mellitus, Obesity, and Hypertension History with Preeclampsia Incidence at Kertapati Health Center,"* reported a significant association between DM and preeclampsia, with a p-value of 0.000 and an OR of 4.6.

Diabetes mellitus is often influenced by placental hormones such as Human Placental Lactogen (HPL), which increases cellular resistance to insulin, leading to diabetes. Approximately half of pregnant women with diabetes mellitus develop preeclampsia due to the placenta's critical role in fetal development. Placental hormones promote fetal growth but also inhibit insulin function in the mother's body, leading to insulin resistance. This resistance prevents glucose from being converted into energy, causing glucose accumulation in the blood and increasing blood sugar levels (Putriana & Yenie, 2019).

The Relationship Between High-Dose Calcium Intake and the Incidence of Preeclampsia in Mothers Giving Birth

PROFESIONAL HEALTH JOURNAL
Volume 7, No. 1, December 2024 (Page. 228-241)
Available Online at https://www.ojsstikesbanyuwangi.com/index.php/PHJ/index
E-ISSN 2715-6249
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Based on the results of the Chi-Square test, the significance value (p-value) was 0.000, indicating a relationship between high-dose calcium intake and the incidence of preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara. With an odds ratio of 6.632, mothers who do not consume high-dose calcium are 6.632 times more likely to experience preeclampsia.

Calcium plays a crucial role in bone and teeth formation, as well as in various physiological and biochemical processes such as blood clotting, nerve and muscle excitability, cell adhesion, nerve impulse transmission, membrane function maintenance, enzymatic reactions, and hormone secretion (Marsetyo, 2015).

A study by Sutiati Bardja (2020) titled *"Risk Factors for Severe Preeclampsia/Eclampsia in Pregnant Women"* found that age, parity, education, hypertension history, family history, weight gain, number of fetuses, and calcium intake were significantly associated with severe preeclampsia/eclampsia in pregnant women in the maternity ward of RSUD Arjawinangun, Cirebon, in 2019. Similarly, research by Andriani & Rusnoto (2019) found a significant relationship between calcium intake and severe preeclampsia at UPT Puskesmas Jepang, with a p-value of 0.009. Regression analysis identified calcium intake as the most influential factor in severe preeclampsia incidence (coefficient = 0.477).

A study by Carole et al. (2019) confirmed a significant statistical relationship between preeclampsia incidence and calcium supplementation in primigravid women. Calcium supplementation during pregnancy was found to reduce the risk of preeclampsia by 11.4% compared to women who did not receive calcium supplementation.

Low calcium intake is associated with an increased risk of preeclampsia in pregnant women. Low calcium levels can contribute to high blood pressure by triggering the release of parathyroid hormone or renin. This leads to increased intracellular calcium levels in vascular smooth muscle, causing vasoconstriction. Research has shown that plasma calcium levels slightly decrease during normal pregnancy and significantly decrease in preeclampsia cases (Kasanova, 2022).

Calcium deficiency is a known risk factor for gestational hypertension, including preeclampsia. During pregnancy, calcium deficiency increases cell membrane permeability, leading to elevated intracellular calcium levels in vascular smooth muscle, resulting in vasoconstriction—a key factor in hypertension development (Zhu et al., 2019).

According to the researcher's assumption, low calcium intake tends to increase the risk of preeclampsia in pregnant women. Low calcium levels can cause high blood pressure by stimulating the release of parathyroid hormone or renin, which increases intracellular calcium in vascular smooth muscle and induces vasoconstriction. The Chi-Square test results showed a significant relationship between high-dose calcium intake and preeclampsia in mothers giving birth at RSUD dr. Dradjat Prawiranegara (p-value = 0.000). With an odds ratio of 6.632, mothers who do not consume high-dose calcium have a 6.632 times higher risk of developing preeclampsia.

Conclusion

The results of this study indicate a significant relationship between body mass index (BMI), history of preeclampsia, weight gain during pregnancy, history of diabetes mellitus (DM), and high-dose calcium intake with the incidence of severe preeclampsia (PEB). Among these factors, a history of preeclampsia is the most dominant determinant based on multivariate analysis. This study is expected to serve as a source of information and input for improving the quality of

PROFESIONAL HEALTH JOURNAL
Volume 7, No. 1, December 2024 (Page. 228-241)
Available Online at https://www.ojsstikesbanyuwangi.com/index.php/PHJ/index
E-ISSN 2715-6249
DOI: https://doi.org/ 10.54832/phj. v7i11528

midwifery services at RSUD Serang and supporting government programs in reducing maternal mortality rate (MMR) and infant mortality rate (IMR) due to preeclampsia. Furthermore, this research is also expected to assist healthcare professionals in providing comprehensive midwifery care and guiding students to become more skilled in managing patients with PEB.

Ethics approval and consent to participate

This research has been granted a research permit from the Research Ethics Committee of Faletehan University, Serang Indonesia based on ethical permit no. 31/KEPK.UF/I/2024.

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