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The Impact of Obesity and Hypertension History on Preeclampsia During Pregnancy

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ABSTRACT

Preeclampsia is the leading cause of maternal mortality and a serious pregnancy complication. Hypertension and obesity in pregnant women are significant risk factors for preeclampsia. This study examined the impact of obesity and high blood pressure history on preeclampsia risk and onset. This quantitative case-control study utilized secondary data from medical records at RSUD Prof. Dr. Margono Soekarjo. A purposive sampling technique selected 314 respondents, with 157 in the case group and 157 in the control group. Data analysis used chi-square tests. The result revealed that obesity (p-value = 0.001, OR = 8.3) and hypertension history (p-value = 0.001, OR = 13.6) were significant risk factors for preeclampsia. However, obesity and hypertension did not affect preeclampsia onset differently. These conditions can lead to endothelial dysfunction and organ damage, increasing preeclampsia risk in pregnant women.

Keywords: Obesity, Early-Onset Preeclampsia, Late-Onset Preeclampsia, Hypertension History

1. INTRODUCTION

Preeclampsia occurs in 2% to 15% of pregnancies and is one of the most frequently reported pregnancy complications (Chang *et al*., 2023). Globally, preeclampsia and eclampsia contribute to over 50,000 maternal deaths annually. The condition significantly impacts maternal and neonatal health worldwide, particularly in developing countries (WHO, UNIPA, UNICEF studies).

Banyumas Regency, Central Java, significantly contributes to the maternal mortality rate (MMR). In 2022, it recorded 24 maternal deaths, or 105.57 per 100,000 live births, with hypertension being the leading cause, accounting for 36.4% of cases (*LPKJ, Central Java Health Department, 2022; Banyumas Health Profile*, 2023). Than *et al*. (2018) identified preeclampsia as a primary cause of maternal and neonatal morbidity and mortality.

Preeclampsia is a pregnancy-related disorder characterized by hypertension, proteinuria, and edema after 20 weeks of gestation. It is classified into early-onset preeclampsia (EOPE) and late-onset preeclampsia (LOPE). EOPE accounts for 5-20% of severe preeclampsia cases caused by abnormal trophoblastic invasion of spiral arteries, leading to impaired placental blood flow. LOPE, comprising about 80% of cases, is more common in women with pre-existing conditions such as diabetes, anemia, or multiple pregnancies (Burhanuddin *et al*., 2018; Cunningham *et al*., 2014; Rana *et al*., 2019).

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The maternal complications of preeclampsia include HELLP syndrome and eclampsia, characterized by hemolysis, elevated liver enzymes, and low platelet count, which may result in maternal and fetal death (Haslan & Trisutrisno, 2022; Putri Ariyan *et al*., 2022). Neonatal complications include intrauterine growth restriction (IUGR), placental abruption, preterm birth, neonatal respiratory distress syndrome, cerebral palsy, necrotizing enterocolitis, retinopathy, and perinatal mortality (Armaly *et al*., 2018).

Several factors increase the risk of preeclampsia, including a history of preeclamptic pregnancies, chronic hypertension, maternal age over 40, race, obesity, multiple pregnancies (twins or more), extended interpregnancy intervals, and preexisting medical conditions such as type 2 diabetes, kidney disease, lupus, or assisted reproductive technologies (e.g., artificial insemination or in vitro fertilization). These risk factors must be considered when providing maternal care (Cunningham *et al*., 2014; Rana *et al*., 2019; Saiffudin, 2016).

Obesity is a significant risk factor for preeclampsia. Research indicates that obesity and preeclampsia increase the likelihood of future cardiovascular disease in mothers. Women with an obese body mass index (BMI) have nearly three times the risk of developing preeclampsia compared to those with a BMI above 30 kg/m2. Other pregnancy-related risks include miscarriage, operative delivery (such as cesarean section), thromboembolism (blood clotting disorders), perinatal mortality (fetal or neonatal death around birth), and macrosomia (newborns with above-average birth weight). Therefore, monitoring BMI and managing weight during pregnancy is crucial for reducing these risks and maintaining maternal and fetal health *(Lopez-Jaramillo et al.*, 2018).

A history of hypertension before pregnancy is another major risk factor for preeclampsia. Women with preexisting hypertension are 7.38 times more likely to develop preeclampsia than those without a history of hypertension (Kasriatun *et al*., 2019). This finding highlights a significant correlation between hypertension and the likelihood of preeclampsia during pregnancy.

The government can reduce preeclampsia cases by enhancing integrated antenatal care services, which help detect preeclampsia early in primary healthcare facilities (Rahayu *et al*., 2020). Identifying preeclampsia risk factors is crucial for preventing complications, increasing awareness, and mitigating preeclampsia and its associated risks (Mutiara *et al*., 2018; Wulandari *et al*., 2021).

Preventive measures should be prioritized to reduce preeclampsia cases. In Indonesia, healthcare professionals, especially midwives, play a critical role in ensuring maternal and child well-being. As frontline healthcare providers, midwives contribute to reducing maternal mortality by promoting health during preconception and pregnancy and by early detection of preeclampsia risk factors (RI, 2023). This necessity drives researchers to analyze the influence of obesity and hypertension history on preeclampsia cases and onset at Prof. Dr. Margono Soekarjo Regional Hospital in Purwokerto. Based on this rationale, further analysis is needed to determine the extent to which obesity and hypertension history contribute to preeclampsia cases and onset at this hospital. This study aimed to identify these risk factors, enable preventive measures, and enhance awareness of preeclampsia and its complications.

2. RESEARCH METHOD

This quantitative study, employing a case-control design, was conducted at Prof. Dr. Margono Soekarjo Regional Hospital in Purwokerto to evaluate the correlation between obesity, hypertension history, and preeclampsia incidence and to compare both factors. The study included 314 pregnant women admitted to the hospital between January and December 2023. The participants were divided into two groups: 157 in the case group, comprising pregnant women diagnosed with preeclampsia, and 157 in the control group, consisting of pregnant women with a gestational age of over 20 weeks. The study utilized all available data from pregnant women at the hospital, applying a non-probability sampling technique. Secondary data were collected from medical records and hospital registries using a checklist form and analyzed using the Chi-Square test.

3. RESULT AND DISCUSSION

3.1 Characteristics of Respondents

Table 1. Frequency Distribution of Characteristics

Characteristics	Group					
	Cases		Control		Total	
	n	%	n	%	n	%
Age						
<20 years old	11	7%	2	1.3 %	13	4.2%
20-35 years old	119	75.8 %	104	66.2 %	223	71.0 %
>35 years old	27	17.2 %	51	32.5 %	78	24.8 %
Parity						
Primipara	74	47.1 %	39	24.8 %	113	36.0 %
Multipara	83	52.9 %	118	75.2 %	201	64.0 %
Occupation						
Employed	25	15.9 %	15	9.6 %	40	12.7 %
Unemployed	132	84.1 %	142	90.4 %	274	87.3 %
Education						
Primary School	30	19.1 %	33	21.0 %	63	20%
Junior High School	44	28.0 %	40	25.5 %	84	26.75 %
Senior High School	62	39.5 %	66	42.0 %	128	40.76 %
University	21	13.4 %	18	11.5 %	39	12.42 %

Table 1 shows that the majority of respondents in both groups were between the ages of 20 and 35 years, accounting for 71.0 percent. Most respondents were multiparous women, with 201 respondents (64.0 percent), and the majority of respondents in the occupational variable were housewives (unemployed), totaling 274 respondents (87.3 percent). Regarding education level, most respondents had a low level of education.

Maternal age is an important factor in evaluating an individual's health. Maternal age is associated with bodily functions that can affect health status during pregnancy. Mothers aged between 20 and 35 years are considered low-risk (safe), whereas those below 20 or above 35 years have a higher risk of pregnancy complications. Furthermore, mothers under 20 years old are at risk of preeclampsia due to the incomplete development of the uterus. On the other hand, structural and functional changes in peripheral blood vessels in women over 35 years lead to degenerative processes that impact blood pressure and increase the risk of preeclampsia (Sudarman *et al*., 2021). However, mothers aged 20 to 35 years can still be susceptible to preeclampsia. This finding aligns Kusuma & Hidayat (2023), who found that individuals aged 20 to 35 are prone to preeclampsia.

Most preeclampsia cases occur in primigravida mothers and those with autoimmune disorders. However, preeclampsia can also occur in multigravida mothers, particularly if other risk factors exist (Hermawati, 2020). Thus, the tendency for risk among primiparous and multiparous women is nearly the same (Welesemayat *et al*., 2020). Another study showed that mothers with more than one child have a greater likelihood of developing preeclampsia. Cases of preeclampsia in multiparous women are twice as high as in primiparous women (Mamlukah & Saprudin, 2018). Additionally, mothers with a parity of 1 or more than 3 have a fivefold increased risk of developing preeclampsia or eclampsia compared to those with a parity of 2 to 3 (Rahmawati & Fauziah, 2019).

Higher education levels tend to impact maternal knowledge positively. Educational status influences an individual's understanding of dietary habits and antenatal visits aimed at early detection of preeclampsia. Moreover, individuals with higher education levels are more likely to process information easily, enabling them to adopt healthier lifestyles (Yuniardiningsih & Hasanah, 2023)

Ernawan *et al*. (2021) explain that housewives are associated with a higher incidence of preeclampsia, but some argue that working mothers have a greater risk. These differing perspectives relate to factors such as physical activity and socioeconomic status. Sufficient physical activity during pregnancy can reduce the risk of preeclampsia. Additionally, low maternal and family income levels can affect maternal nutritional intake and access to healthcare services.

Table 2. Frequency Distribution of

No	Preeclampsia Onset	Frequency (f)	Percentage (%)
1	Early-Onset Preeclamsia (PEAD)	69	43,95%
2	Late-Onset Preeclamsia (PEAL)	88	56,05%
	Total	157	100%

Preeclampsia Onset

Based on Table 2, most respondents in the preeclampsia group experienced late-onset preeclampsia (56.05%), while early-onset preeclampsia accounted for 43.95%. This data indicates that many preeclampsia cases are diagnosed at gestational age ≥ 34 weeks. Approximately 80% of preeclampsia cases are late-onset and are mostly associated with normal fetal growth and the absence of blood flow disturbances in the umbilical cord. This condition poses a greater risk for mothers with large and extensive placentas, such as in multiple pregnancies, diabetes, and anemia (Burhanuddin *et al*., 2018).

3.2 Correlation between Obesity and Preeclampsia

Table 3. Correlation between Obesity and Preeclampsia

Variable	Group		Total	P Value	OR 95% CI
	Preeclamsia (PE)	No PE			
Obesity	119 (73.5%)	43 (26.5%)	162 (100%)	0,001	8.3 5.0-13.7
Non-Obesity	38 (25%)	114 (75%)	152 (100%)		
Total	157 (50%)	157 (50%)	314 (100%)		

Table 3 demonstrates a significant correlation between maternal obesity and preeclampsia ($p < 0.05$). Obese pregnant women are 8.3 times more likely to develop preeclampsia than non-obese pregnant women. This finding supports the study by Yuniarti *et al*. (2023), which identified a significant correlation between obesity and preeclampsia. Additionally, pregnant women with obesity are 2.6 times more likely to develop preeclampsia than those without obesity. Other studies have found that obese pregnant women are 5.3 times more likely to develop preeclampsia than non-obese women (Armani *et al.*, 2020; Kasriatun *et al*., 2019). Genetic factors, metabolic disorders, and excessive eating habits contribute to obesity.

Obesity leads to insulin resistance and increases blood cholesterol levels. Insulin resistance activates the sympathetic nervous system, causes sodium retention in the kidneys, and increases cation transport, raising blood pressure during pregnancy. Under these conditions, placental ischemia may occur, increasing antiangiogenic and pro-inflammatory factors such as TNF-α and Interleukin (IL)-6. Endothelial dysfunction, a primary cause of preeclampsia, is also linked to obesity (Fox *et al*., 2019; Kasriatun *et al*., 2019; Lopez-Jaramillo *et al*., 2018).

3.3 Correlation between Hypertension History and Preeclampsia Incidence

Table 4. Correlation between Hypertension History and Preeclampsia

Variable	Group		Total	P Value	OR 95 % CI
	PE	Non-PE			
History of Hypertension	61 (89.7%)	7 (10.3%)	68 (100%)	0.001	13.6 5.9-31
No History of Hypertension	96 (39%)	150 (61%)	246 (100%)		
Total	157 (50%)	157 (50%)	314 (100%)		

Table 4 demonstrates a significant correlation between maternal hypertension history and preeclampsia incidence ($p < 0.05$). Pregnant women with a history of hypertension are 13.6 times more likely to develop preeclampsia compared to those without such a history.

Additional studies support this finding. Rezeki & Ayuningtyas (2014) identified a significant correlation between preeclampsia and hypertension history (p = 0.005). Tamaledu Wantania & Wariki (2023) also revealed a significant association between maternal hypertension history and preeclampsia (p = 0.011; p = 0.05). Lalita (2019) explained that pregnant women with a history of hypertension have a 4.2 times higher risk of developing preeclampsia than those without hypertension. Elevated blood pressure before pregnancy can cause substantial organ damage, impair bodily functions, and increase the risk of pregnancy complications such as edema and proteinuria.

Preeclampsia occurs more frequently due to long-term hypertension, which is linked to placental vascular problems (Cunningham *et al*., 2014). Furthermore, a history of high blood pressure before pregnancy can cause complications in vital organs, hinder fetal development, and lead to preeclampsia. The most common symptoms of this condition include edema and proteinuria (Octavia & Siahaan, 2023; Phipps *et al*., 2019). Hypertension, a long-diagnosed medical condition, has the potential to increase maternal mortality and morbidity rates. Early-onset hypertension during pregnancy is associated with a higher risk of complications and a worse prognosis (Septiani, 2024).

3.4. Correlation between Obesity and Preeclampsia Onset

Tabel 5. Correlation between Obesity and Preeclampsia Onset

Variable	PE Onset		Total	P Value	OR 95% CI
	PEAD	PEAL			
Obesity	51 (42.9%)	68 (57.1%)	119 (100%)	0.626	0.83 0.40-1.73
Non-Obesity	18 (47.4%)	20 (52.6%)	38 (100%)		
Total	69 (43.9%)	88 (56.1%)	157 (100%)		

The analysis of obesity differences in pregnant women with early-onset preeclampsia (PEAD) and late-onset preeclampsia (PEAL) is shown in Table 5. The chi-square test results (p = 0.626; p > 0.05) indicate no significant difference between obese and non-obese mothers regarding preeclampsia onset. This is because obesity is a risk factor for all cases of preeclampsia, regardless of onset type.

Robillard *et al*. (2019) stated that p = 0.06 (p > 0.05) is considered insignificant, indicating no difference in obesity prevalence between PEAD and PEAL. They reported that obesity poses a similar risk for both PEAD and PEAL, using binary classification (BMI 30+/-, yes/no). However, other studies examining preeclampsia onset categories reported that obesity specifically increases the risk of PEAL but not PEAD (Lin *et al*., 2021). The mechanisms by which obesity leads to preeclampsia may include dyslipidemia, insulin resistance, hyperinsulinemia, oxidative stress, and endothelial dysfunction. Obesity can increase blood cholesterol levels and induce insulin resistance, leading to elevated blood pressure during pregnancy due to heightened sympathetic nervous system activity. This, in turn, causes renal sodium retention and enhances cation transport, resulting in endothelial dysfunction and multi-organ disorders (Robillard *et al*., 2019).

The classification of preeclampsia based on onset is influenced by factors affecting disease pathogenesis. In preeclampsia related to abnormal placental development (PEAD), placental abnormalities such as inadequate trophoblast invasion are observed. Insufficient trophoblast invasion leads to improper spiral artery remodeling, reducing uterine blood flow to the placenta and impacting fetal growth. In contrast, maternal condition-related preeclampsia (PEAL) is influenced by factors such as diabetes and obesity. Unlike PEAD, PEAL typically does not involve abnormal trophoblast invasion but rather maternal health conditions that contribute to preeclampsia development (Burhanuddin *et al*., 2018).

3.5 Correlation between Hypertension History and Preeclampsia Onset

The analysis of the correlation between maternal hypertension history and preeclampsia onset (PEAD and PEAL) is shown in Table 6. The chi-square test results (p = 0.95; p > 0.05) indicate no significant difference between individuals with and without hypertension history regarding preeclampsia onset. This finding suggests that obesity is a risk factor for

all preeclampsia cases, regardless of onset timing.

Table 6. Correlation between Hypertension History and Preeclampsia Onset

Variable	PE Onset		Total	P Value	OR 95% CI
	PEAD	PEAL			
History of Hypertension	27 (44.3%)	34 (55.7%)	61 (100%)	0.95	1.021 0.53-1.94
No History of Hypertension	42 (43.8%)	54 (56.3%)	96 (100%)		
Total	69 (50%)	88 (50%)	157 (100%)		

A study by (Robillard *et al*., 2019), found that the odds ratio for chronic hypertension was higher for PEAD than for PEAL, a result consistent with previous research. The pathophysiology of preeclampsia in pregnant women with chronic hypertension remains unclear and may be due to hemodynamic disturbances. Impaired placental perfusion is known to contribute to preeclampsia development. Research suggests that pregnant women with hypertension may experience hemodynamic dysfunction, leading to an imbalance of systemic vascular endothelial factors, particularly in the placenta (Lin *et al*., 2021).

Differences in findings between this study and previous research may be attributed to the smaller sample size, which limits the comparability of results. Robillard *et al*., (2019) conducted an 18-year cohort observational study, identifying chronic hypertension and preeclampsia history in multigravida women as primary risk factors for PEAD. This contrasts with the present study, which analyzed samples over one year.

4. CONCLUSION

Obesity and hypertension history significantly influence preeclampsia incidence in pregnant women, leading to endothelial dysfunction and vital organ damage, thereby increasing preeclampsia risk. However, obesity and hypertension history do not affect preeclampsia onset, as obesity is a risk factor for both PEAD and PEAL.

5. RESEARCH LIMITATIONS

The relatively small sample size does not adequately capture differences in hypertension history and preeclampsia onset (PEAD vs. PEAL).

6. RECOMMENDATIONS

Healthcare professionals, especially midwives in peripheral healthcare services, should provide consultation, information, and education regarding the importance of early detection of danger signs during pregnancy, particularly preeclampsia. It is crucial to understand the factors influencing the occurrence of preeclampsia and to determine obesity status at an early stage. Additionally, obtaining a thorough history of maternal hypertension can help healthcare providers be more vigilant about the potential occurrence of preeclampsia in pregnant women, with the ultimate goal of reducing the incidence of preeclampsia.

This study can serve as a foundation for further research to achieve more comprehensive results. Expanding the research sample size and geographical coverage, as well as incorporating additional characteristics and other influencing factors, particularly those related to the onset of preeclampsia, would enhance the study's depth. Early detection of risk factors for preeclampsia enables healthcare professionals to be more vigilant and play a significant role in educating pregnant women at risk of developing preeclampsia. The ultimate goal is to contribute to reducing maternal mortality rates caused by preeclampsia and its complications.

REFERENCE

Armaly, Z., Jadoan, J. ., Jabbour, A., & Abasi, Z. . (2018). Preeclampsia: Novel Mechanisms and Potential Therapeutic Approaches. Frontiers in Physiology, 9, 973–988. https://doi.org/https://doi.org/10.3389/fphys.2018.00973

Armani, A., Yunola, S., & Anggraini, H. (2020). Hubungan Riwayat Hipertensi, Obesitas, dan Frekuensi Antenatal Care dengan Kejadian Preeklampsia. *Jurnal 'Aisyiyah Medika*, 7(2), 237–245.

Burhanuddin, S., Krisnadi, S. ., & Pusianawati, D. (2018). Gambaran Karakteristik dan Luaran pada Preeklamsi Awitan Dini dan Awitan Lanjut di RSUP Dr. Hasan Sadikin Bandung. OBGYNIA, 1(2), 117–133.

Chang, K.-J., Seow, K.-M., & Chen, K.-H. (2023). Preeclampsia: Recent Advances in Predicting, Preventing, and Managing the Maternal and Fetal Life-Threatening Condition. *International Journal of Environmental Research and Public Health*, 20(4), 2994–3022. https://doi.org/https://doi.org/10.3390/ijerph20042994

Cunningham, F. ., Leveno, K. ., Bloom, S. L., & Hauth, J. C. (2014). Obstetri Wiliams (Vol. 23, Issue 2). Penerbit EGC.

Ernawan, P. ., Tampubolon, R., & Bagus, R. (2021). Identifikasi Faktor-Faktor Terkait Kejadian Preeklampsia Pada Ibu Hamil di Kabupaten Semarang. *Jurnal Sains Dan Kesehatan* (J Sains Kes), 3(2), 269–277. https://doi.org/https://doi.org/10.25026/jsk.v3i2.241

Fox, R., Kitt, J., Leeson, P., Aye, C. Y. ., & Lewandowski, A. . (2019). Preeclampsia: Risk Factors, Diagnosis, Management, and the Cardiovascular Impact on the Offspring. *Journal of Clinical Medicine*, 8(10), 1625. https://doi.org/https://doi.org/10.3390/jcm8101625

Haslan, H., & Trisutrisno, I. (2022). Dampak Kejadian Preeklampsia dalam Kehamilan Terhadap Pertumbuhan Janin Intrauterine. *Jurnal Ilmiah Kesehatan Sandi Husada*, 445–454. https://doi.org/https://doi.org/10.35816/jiskh.v11i2.810

Hermawati, D. (2020). Hubungan Paritas dan Usia Ibu Hamil dengan Preeklampsia di Rumah Sakit Kota Banda Aceh. Idea Nursing Journal, IX(3), 62–69.

Kasriatun, K., Kartasurya, M. ., & Nugraheni, S. . (2019). Faktor Risiko Internal dan Eksternal Preeklampsia di Wilayah Kabupaten Pati Provinsi Jawa Tengah. *Jurnal Manajemen Kesehatan Indonesia*, 7(1), 30–38. https://doi.org/https://doi.org/10.14710/jmki.7.1.2019.30-38

Kusuma, N. C. ., & Hidayat, F. (2023). Karakteristik Preeklampsia Berdasarkan Early Onset Preeclampsia (EOPE) DAN Late Onset Preeclampsia (LOPE) RSUD Dr Slamet Garut Jawa Barat. *Jurnal Medika Malahayati*, 7(3). https://doi.org/https://doi.org/10.33024/jmm.v7i3.10772

Lalita, E. M. F. (2019). Analisis Faktor Risiko Kejadian Preeklampsia Di Manado. *JIDAN (Jurnal Ilmiah Bidan)*, 6(1), 8–16. https://doi.org/https://doi.org/10.47718/jib.v6i1.601

Lin, L., Huai, J., Su, R., Wang, C., Li, B., & Yang, H. (2021). Incidence and Clinical Risk Factors for Preeclampsia and Its Subtypes: A Population-Based Study in Beijing, China. Maternal-Fetal Medicine, 3(2), 91–99. https://doi.org/https://doi.org/10.1097/FM9.0000000000000099

Lopez-Jaramillo, P., Barajas, J., Rueda-Quijano, S. ., Lopes-Lopes, C., & Felix, C. (2018). Obesity and Preeclampsia: Common Pathophysiological Mechanisms. Frontiers in Physiology, 9. https://doi.org/https://doi.org/10.3389/fphys.2018.01838

LPKJ Dinas Kesehatan Provinsi Jawa Tengah Tahun 2022. (2022). Dinkes Prov. Jawa Tengah.

Mamlukah, & Saprudin, A. (2018). Gambaran Karakteristik Ibu Hamil Dengan Risiko Preeklampsia (Studi di Puskesmas Kabupaten Majalengka). *Jurnal Ilmu Kesehatan Bhakti Husada: Health Sciences Journal*, 9(2), 8–16. https://doi.org/https://doi.org/10.34305/jikbh.v9i2.62

Mutiara, B., Amirus, K., Aryastuti, N., Wulandari, R., & Sudirayu, I. (2018). Analisis Faktor Risiko yang Mempengaruhi Tekanan Darah dan Protein Urine pada Ibu dengan Preeklampsia di RSUD DR. H. Abdul Moeloek Provinsi Lampung 2017. JKMK: *Jurnal Kesmas (Kesehatan Masyarakat) Khatulistiwa*, 5(2), 48–55.

Octavia, H., & Siahaan, S. C. P. . (2023). Hubungan Riwayat Hipertensi, Indeks Massa Tubuh dan Usia Ibu pada Wanita Hamil dengan Kejadian Preeklampsia di Rumah Sakit Kristen Mojowarno Tahun 2020. *Jurnal Kedokteran Universitas Palangka Raya*, 11(2). https://doi.org/https://doi.org/10.37304/jkupr.v11i2.9529

Phipps, E. ., Thadani, R., Benzing, T., & Karumanchi, S. . (2019). Pre-eclampsia: Pathogenesis, Novel Diagnostics and Therapies. *Nature Reviews Nephrology*, 15(5), 275–289. https://doi.org/https://doi.org/10.1038/s41581-019-0119-6

Profil Kesehatan Kabupaten Banyumas Tahun 2022. (2023). Dinkes Kab. Banyumas.

Putri Ariyan, F. ., Sukowati, E. ., & Fatmawati, W. (2022). Preeclampsia correlates with maternal and perinatal outcomes in Regional Public Hospital, Madiun, Indonesia. Majalah Obstetri & Ginekologi, 30(1), 24–31. https://doi.org/https://doi.org/10.20473/mog.V30I12022.24-31

Rahayu, A. ., Astuti, A. ., & Utami, F. . (2020). Pengalaman ibu dengan riwayat preeklampsia dalam kehamilan: scooping review. *Jurnal Riset Kebidanan Indonesia*, 3(2), 56–68. https://doi.org/https://doi.org/10.32536/jrki.v3i2.55

Rahmawati, R., & Fauziah, F. (2019). Resiko Umur dan Paritas Ibu Hamil pada Kejadian Preeklampsia Eklampsi. *Bunda Edu Midwifery Journal (BEMJ)*, 2(1), 33–39.

Rana, S., Lemoine, E., Granger, J. ., & Karumanchi, S. . (2019). Preeclampsia: Pathophysiology, Challenges, and Perspectives. *Circulation Research*, 124(7), 1094–1112. https://doi.org/https://doi.org/10.1161/CIRCRESAHA.118.313276

Rezeki, S. ., & Ayuningtyas, D. (2014). Kualitas Lingkungan Kerja dan Kinerja Bidan Puskesmas dalam Pelayanan Kesehatan Ibu. *Jurnal Kesehatan Masyarakat Nasional*, 8(6), 265–271.

RI, K. (2023). Profil Kesehatan Indonesia Tahun 2022.

Robillard, P.-Y., Dekker, G., Scioscia, M., Bonsante, F., Lacobelli, S., Boukerrou, M., & Hulsey, T. . (2019). Increased BMI has a linear association with late-onset preeclampsia: A population-based study. *PLOS ONE*, 14(10). https://doi.org/https://doi.org/10.1371/journal.pone.0223888

Saiffudin, A. B. (2016). Ilmu Kebidanan Sarwono Prawirohardjo.

Septiani, T. (2024). Hubungan Antara Riwayat Hipertensi dan Obesitas Ibu Hamil dengan Kejadian Preeklampsia di Rumah Sakit Islam Siti Khadijah Palembang Tahun 2023. *Madani: Jurnal Ilmiah Multidisiplin*, 2(4), 644–648. https://doi.org/https://doi.org/10.5281/zenodo.13252809

Sudarman, Tendean, H. M. M., & Wagey, F. W. (2021). Faktor-Faktor yang Berhubungan dengan Terjadinya Preeklampsia. *E-CliniC*, 9(1). https://doi.org/https://doi.org/10.35790/ecl.v9i1.31960

Tamaledu Wantania, J. J. E., & Wariki, W. M. V. (2023). Faktor-Faktor yang Berhubungan dengan Kejadian Preeklampsia di RSUP Prof. Dr. R. D. Kandou Manado. *PREPOTIF: Jurnal Kesehatan Masyarakat*, 7(1), 846–856. https://doi.org/https://doi.org/10.31004/prepotif.v7i1.13091

Than, N. ., Romero, R., Tarca, A. ., Kekesi, K. ., Xu, Y., Xu, Z., Juhasz, K., Batti, G., Leavitt, R. ., Gelencser, Z., Palhalmi, J., Chung, T. ., Gyorffy, B. ., Orosz, L., Demeter, A., Szecsi, A., Hunyai-Gulyas, E., Darula, Z., Simor, A., & Papp, Z. (2018). Integrated Systems Biology Approach Identifies Novel Maternal and Placental Pathways of Preeclampsia. Frontiers in Immunology, 9. https://doi.org/https://doi.org/10.3389/fimmu.2018.01661

Welesemayat, E. ., Taye, G., Seid, Y., Fetwi, F. ., & Gufue, Z. . (2020). Effect of Preeclampsia on the Incidence Rate of

Small-for-gestation-age of The Fetuses Among Pregnant Women in Selected Public Hospitals in Tigray, Northern Ethiopia. Ethiop. J. Health, 34(3).

Wulandari, E. ., Ernawati, E., & Nuswantoro, D. (2021). Risk Factors of Preeclampsia with Severe Features and Its Complication. *Indonesian Midwifery and Health Sciences Journal*, 5(1), 29–37. https://doi.org/https://doi.org/10.20473/imhsj.v5i1.2021.29-37

Yuniardiningsih, E., & Hasanah, Y. W. (2023). Pengaruh Tingkat Pendidikan Dan Pengetahuan Terhadap Kejadian Preeklampsia. *Medical Jurnal Of Al-Qodiri*, 8(1), 70–74. https://doi.org/https://doi.org/10.52264/jurnal_stikesalqodiri.v8i1.237

Yuniarti, T., Rohmi, R., Atmoo, J. ., Mustain, M., Anasulfalah, H., & Widiyanto, A. (2023). Risiko Kejadian Pre-Eklampsia pada Ibu Hamil dengan Obesitas. *Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal*, 13(4), 1265–1274. https://doi.org/https://doi.org/10.32583/pskm.v13i4.1271