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SENSITIVITY AND SPECIFICITY OF BLOOD PRESSURE AND WEIGHT GAIN IN PREGNANT WOMEN TO THE INCIDENCE OF PREECLAMPSIA

Sensitivitas Dan Spesifisitas Tekanan Darah Dan Peningkatan Berat Badan Ibu Hamil Terhadap Kejadian Preeklamsia

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ABSTRAK

Preeklamsia masih menjadi penyebab utama komplikasi kehamilan di Indonesia. Penatalaksanaan kasus yang tepat selama kehamilan dapat mencegah preeklamsia. Penelitian bertujuan untuk mengetahui sensitivitas dan spesifisitas tekanan darah, MAP, dan pertambahan berat badan kehamilan terhadap kejadian preeklamsia Desain penelitian eksploratif dengan pendekatan potong lintang. Penelitian dilakukan di Kabupaten Karawang pada Maret sampai Desember 2022. Sampel 165 responden dari ibu yang mempunyai bayi, dipilih secara acak. Kriteria sampel responden melakukan pemeriksaan antenatal minimal 6 kali selama kehamilan. Ibu memiliki buku KIA yang mencatat tekanan darah, berat badan dan tinggi badan serta melahirkan pada cukup bulan. Pengolahan menggunakan SPSS versi 21 dengan uji sensitivitas dan spesifisitas. Hasil analisis sensitivitas sistole dan diastole serta MAP memiliki sensitivitas di atas 90%, kecuali sistole pada kehamilan kurang dari 24 minggu 83% (CI: 1,14-6,85). Spesifisitas tertinggi ditemukan pada diastole kehamilan di atas 24 minggu (0,96). Hasil terbaik pada sistole kehamilan di atas 24 minggu dengan sensitivitas 92% (CI: 37,12-2427,28). dan spesifisitas 0,96. hasil ini membuktikan tekanan darah sistole, diastole, dan MAP dapat digunakan sebagai deteksi yang kuat untuk preeklamsia. Disarankan adanya regulasi dan SOP dalam pelaksanaan layanan ini.

Kata kunci: preeklamsia, sensitivitas, spesifisitas, tekanan darah

ABSTRACT

Preeclampsia is still the main cause of pregnancy complications in Indonesia. Proper case management during pregnancy can prevent preeclampsia. The study aims to determine the sensitivity and specificity of blood pressure, MAP, and pregnancy weight gain to the incidence of preeclampsia. Research design with exploration, by a cross-sectional approach. The research was carried out in Karawang Regency from March to December 2022. Samples of 165 respondents from mothers who had babies were randomly selected. The criteria for the respondent sample are to conduct antenatal examinations at least 6 times during pregnancy. The mother has a KIA book that records blood pressure, weight, height, and birth at term. Data analyze by SPSS version 21 with sensitivity and specificity tests. The results of the sensitivity analysis of systole, diastole, and MAP had sensitivity above 90%, except for systole in less than 24 weeks of pregnancy at 83% (CI: 1.14-6.85). The highest specificity was found in gestational diastole over 24 weeks (0.96). Best results in systoles of pregnancy over 24 weeks with a sensitivity of 92% (CI: 37.12-2427.28), and specificity of 0.96. These results prove that systole, diastole, and MAP blood pressure can be used as powerful detectors for preeclampsia. It is recommended that there be regulations and SOPs in the implementation of this service.

Keywords: *blood pressure, preeclampsia, sensitivity, specificity*

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INTRODUCTION

Hypertension in pregnancy (HDK) is a major cause of maternal and neonatal morbidity and mortality. The maternal mortality rate attributable to HDK reaches 14% worldwide[1], [2]. HDK, which includes preeclampsia, is defined as hypertension with onset or worsening after 20 weeks of gestation. Positive urine protein and organ dysfunction are commonly found in association with HDK[3].

The impact of preeclampsia is not limited to pregnancy, childbirth, and the postpartum period, but also afterward and on the unborn child. In certain circumstances, preeclampsia can lead to Early Vascular Angiogenesis (EVA). In severe preeclampsia, the incidence of EVA is 9.23 times higher, while in mild preeclampsia, the incidence is 7.87 times higher than in those without preeclampsia[4]. A study of antihypertensive drug use in the intervention group and no drug in the control group found that preterm births at less than 37 weeks were 27.5% in the intervention group and 31.4% in the control group, while low birth weight was 19.2% in the intervention group and 23.1% in the control group. There was no difference in severe neonatal complications between the two groups[5]. It means that antihypertensive medication reduces the risk of premature births and low birth weight by less than 4%. Furthermore, babies born to mothers with preeclampsia are associated with asthma, neonatal RDS, and increased pulmonary artery pressure[6].

Elevated blood pressure during pregnancy serves as a screening tool to identify the possibility of preeclampsia by determining mean arterial pressure (MAP). The American Heart Association (AHA) states that normal blood pressure in pregnant women is less than 120 mmHg systolic and less than 80 mmHg diastolic.[7]. The AHA further defines stage 1 hypertension if systolic blood pressure between 130 and 199 mmHg and diastolic blood pressure between 80 and 90 mmHg. In Indonesia, the diagnosis of preeclampsia is based on systolic blood pressure (BP) of 140 mmHg or greater and diastolic blood pressure of 90 mmHg or greater, accompanied by the presence of protein in the urine. This benchmark is equivalent to stage II hypertension as defined by the AHA. Systolic blood pressure has a correlation of 0.52 with the occurrence of preeclampsia, while diastolic blood pressure has a correlation of 0.49 with the same condition[8]. The hypertension standard used in this study is in accordance with that set by the Indonesian Ministry of Health, namely 140/90 mmHg. Although many risks are posed by increased blood pressure during pregnancy, currently, blood pressure is categorized as systolic/diastolic, and no separate increase, while MAP is categorized as a moderate risk; only chronic hypertension is categorized as a severe risk of preeclampsia[9]. This allows for earlier detection of preeclampsia. Standard ANC services require six antenatal checkups, with three more after 24 weeks of pregnancy, as the pregnancy enters the third trimester. In Karawang Regency, the K6 achievement decreased from 95.9% in 2020 to 89.4% in 2022. This undoubtedly impacts blood pressure monitoring in pregnant women[10].

Another factor that indicates the possibility of preeclampsia is weight gain (BWG) that exceeds the standard. The average weight gain in pregnant women is 11.5–16 kg for women with a normal Body Mass Index (BMI). The BWG for pregnancy corresponds to the mother's pre-pregnancy BMI, but on a pregnancy chart, a 10 kg gain is within the normal range[9]. This study aimed to determine the sensitivity and specificity of blood pressure and weight gain in patients with preeclampsia.

METHODS

This research is an exploratory study with a cross-sectional design. Respondents were mothers with infants in Karawang Regency. The study was conducted in Karawang Regency from March to December 2022. Sampling was conducted using cluster sampling based on the location of community health centers. Of the 36 existing

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community health centers, four were selected as study locations. The sample size was determined using the Lemeshow formula, resulting in 165 respondents. Sampling at each community health center was carried out proportionally based on the number of deliveries, with sample selection using serial numbers that are multiples of two. Inclusion criteria for this study included mothers without a history of chronic hypertension, no diagnosis of diabetes, and singleton pregnancies. Exclusion criteria were mothers who were unable to show their KIA (Child Health Card) or had an incomplete KIA (Child Health Card) book.

In this study, the highest systolic and diastolic blood pressures were recorded at prenatal visits before 24 weeks (first and second trimesters) and at ≥24 weeks of gestation (third trimester), then used to calculate Mean Arterial Pressure (MAP). Weight gain during pregnancy was calculated from the difference between pre-pregnancy weight and weight at the in-partum visit. The incidence of preeclampsia was determined based on the medical diagnosis made at delivery.

Data collection was conducted using secondary data sourced from the KIA handbook and medical records at health care facilities. A checklist was used to assess the completeness and consistency of data between the KIA handbook and medical records, while a questionnaire was used to investigate the mother's and her family's history of hypertension. The initial stage of data collection was conducted through a study of birth records to identify birth data from April 2021 to May 2022. The data was then traced to the integrated health service post (Posyandu) to ensure mothers owned a KIA handbook. Each respondent's KIA handbook was then inspected directly. Respondents who met the inclusion criteria were mothers with living children and had a KIA handbook completely filled out according to the required data. If there was any doubt about the data, confirmation was made through ANC records at the community health center, the Independent Midwife Practice (PMB), or the Posyandu.

Data analysis was performed to determine frequency distribution and relationships between variables using the chi-square test, as well as sensitivity and specificity analysis using SPSS. This study has obtained ethical approval from the Ethics Committee of the Bandung Ministry of Health Polytechnic under number 115/KEPK/BC/IV/2022.

RESULTS

Table 1. Distribution of Respondents Based on Preeclampsia Incidence

Preeclampsia	n	%
1. No eclampsia	138	83.6
2. Eclampsia	27	16.4
Amount	165	100

Table 1shows the distribution of respondents based on the incidence of preeclampsia. Of the 165 respondents, the majority, 138 (83.6%), did not experience eclampsia. Meanwhile, 27 (16.4%) experienced eclampsia. This finding indicates that the majority of mothers in this study did not experience eclampsia, although the proportion of preeclampsia cases was still significant enough to warrant further analysis.

Table 2 describes the relationship between increased blood pressure (systolic, diastolic, and Mean Arterial Pressure/MAP) and increased body weight during pregnancy with the incidence of preeclampsia. The analysis results showed that systolic and diastolic blood pressure, both at gestational age <24 weeks, >24 weeks, and during labor, had a significant relationship with the incidence of preeclampsia (p <0.05), except for diastolic pressure at gestational age <24 weeks, which did not show a significant relationship (p = 0.111). The Odds Ratio (OR) value tended to increase with increasing gestational age, which indicates that the more advanced the gestational age, the greater the risk of preeclampsia if blood pressure increases.

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The highest OR values were found for diastolic blood pressure in pregnancies >24 weeks (OR = 300; 95% CI: 37.12–24.27) and systolic blood pressure in labor (OR = 130; 95% CI: 32.17–52.35). These very high OR values are likely influenced by the mother's physiological and psychological conditions prior to delivery, such as contractions, pain, and anxiety, which can acutely increase blood pressure. Furthermore, differences in blood pressure measuring instruments and the possibility of a history of undetected preeclampsia may also influence the magnitude of the OR values.

Mean Arterial Pressure (MAP) at gestational age >24 weeks was also shown to be significantly associated with the incidence of preeclampsia (p = 0.038), with a risk 2.97 times higher in mothers with MAP ≥90 mmHg compared to MAP <90 mmHg. In contrast, weight gain during pregnancy did not show a significant association with the incidence of preeclampsia (p = 0.708). This suggests that blood pressure plays a more dominant role than weight gain.

Table 2. Distribution of Respondents Based on the Increase in MAP Blood Pressure and Increase in Weight During Pregnancy on the Incidence of Preeclampsia

Variables	Pre-eclampsia				n	%	p-value	OR CI 95%
	No		Pre-eclampsia					
	n	%	n	%				
Pregnancy Systole < 24 Weeks							0.041	2.79 1.14 – 6.85
1. < 140 mmHg	114	87	17	13	131	100		
2. ≥ 140 mmHg	24	70.6	10	29.4	34	100		
Diastole of pregnancy <24 weeks							0.111	2.82 0.78 – 10.15
1. < 90 mmHg	130	85	23	15	153	100		
2. ≥ 90 mmHg	8	66.7	4	33.3	12	100		
Systole of pregnancy >24 weeks							0,000	46.2 14.81 – 144.07
1. < 140 mmHg	126	92.2	5	3.8	131	100		
2. ≥ 140 mmHg	12	35.3	22	64.7	34	100		
Diastole of pregnancy >24 weeks							0,000	300 37.12 – 2427.28
1. < 90 mmHg	127	99.2	1	0.8	128	100		
2. ≥ 90 mmHg	11	29.7	26	70.3	37	100		
Inpartu Systole							0,000	130 32.17 – 525.35
1. < 140 mmHg	130	97.7	3	2.3	133	100		
2. ≥ 140 mmHg	8	25	24	75	32	100		
Diastole in labor							0,000	47.2 12.98 – 171.53
1. < 90 mmHg	118	97.5	3	2.5	121	100		
2. ≥ 90 mmHg	20	45.5	24	54.5	44	100		
MAP Pregnancy > 24 Weeks							0.038	2.97 1.12 – 7.77
1. < 90 mmHg	119	86.2	19	13.8	138	100		
2. ≥ 90 mmHg	17	68	8	32.7	25	100		
Weight Gain During Pregnancy							0.708	0.78 0.34 – 1.78
1. < 10 Kg	58	81.7	13	18.3	71	100		
2. ≥ 10 Kg	80	85.1	14	14.9	94	100		

*Chi-Square

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Sensitivity and specificity analysis of blood pressure

Table 3. Sensitivity and Specificity of Increased Blood Pressure, MAP, and Weight Gain During Pregnancy Against Preeklampsia

Variables	Pre-eclampsia				n	%	Sensitivity	Specificity	CI 95%
	No		Pre-eclampsia						
	n	%	n	%					
Systole <24 Weeks									
1. < 140 mmHg	114	87	17	13	131	100	0.83	0.37	1.14 – 6.85
2. ≥ 140 mmHg	24	70.6	10	29.4	34	100			
Diastole <24 Weeks									
1. < 90 mmHg	130	85	23	15	153	100	0.94	0.15	0.78 – 10.15
2. ≥ 90 mmHg	8	66.7	4	33.3	12	100			
Systole >24 weeks									
1. < 140 mmHg	126	92.2	5	3.8	131	100	0.92	0.81	14.81 – 144.07
2. ≥ 140 mmHg	12	35.3	22	64.7	34	100			
Diastole >24 Weeks									
1. < 90 mmHg	127	99.2	1	0.8	128	100	0.92	0.96	37.12 – 2427.28
2. ≥ 90 mmHg	11	29.7	26	70.3	37	100			
Inpartu Systole									
1. < 140 mmHg	130	97.7	3	2.3	133	100	0.94	0.89	32.17 – 525.35
2. ≥ 140 mmHg	8	25	24	75	32	100			
Diastole in labor									
1. < 90 mmHg	118	97.5	3	2.5	121	100	0.86	0.89	12.98 – 171.53
2. ≥ 90 mmHg	20	45.5	24	54.5	44	100			
MAP > 24 Weeks									
1. < 90 mmHg	119	86.2	19	13.8	138	100	0.86	0.89	1.12 – 7.77
2. ≥ 90 mmHg	17	68	8	32.7	25	100			
MAP > 24 Weeks									
1. < 90 mmHg	130	85	23	15	153	100	0.94	0.15	0.34 – 1.78
2. ≥ 90 mmHg	8	66.7	4	33.3	12	100			
Weight Gain During Pregnancy									
1. < 10 Kg	58	81.7	13	18.3	71	100	0.94	0.15	1.14 – 6.85
2. ≥ 10 Kg	80	85.1	14	14.9	94	100			

*Chi-Square

Based on the analysis in Table 3, the highest sensitivity values were found in systolic pressure at gestational age up to 24 weeks, inpartu systolic pressure of 0.94 with a specificity of 15% (CI: 0.78 - 10.15), and weight gain of 0.94 with a specificity of 0.15% (CI: 1.14 - 6.85). The best systolic pressure was found in pregnancies of more than 24 weeks with a sensitivity of 0.92 and a specificity of 0.81 (CI = 14.81 - 144.07). This means that a systolic pressure greater than or equal to 140 mmHg in pregnancies of more than 24 weeks can predict the possibility of preeclampsia by 92%, while the accuracy in detecting errors reached 81% with a CI of 37.12 - 2427.28. Meanwhile, systolic sensitivity during inpartum was 0.94, with a specificity of 0.89% with a CI of 32.17 - 525.35. The best diastolic in detecting preeclampsia was in the group of pregnancies over 24 weeks with a sensitivity of 92% and a specificity of 0.96. During inpartum, systolic was able to predict preeclampsia by 94% with a specificity of 0.89, with a CI of 12.41-6.85. In systolic and diastolic pregnancies above 24 weeks, confidence intervals were found with a high range. This may be due to the determination of blood pressure taken from the highest results during prenatal checkups, without considering gestational age.

The sensitivity of MAP (Majority Blood Pressure Index) at gestational age up to 24 weeks is significantly higher for eclampsia than the same MAP at gestational age above

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24 weeks. Meanwhile, a GWD of more than 10 kg during pregnancy is more sensitive to preeclampsia than a weight gain of less than 10 kg. In addition to blood pressure, preeclampsia can be predicted by the sensitivity of MAP and GWD.

DISCUSSION

Hypertension in pregnancy is still a disease with various theories (the disease of theory). Although there are many theories, none has been revealed pathologically[11]. Elevated blood pressure is the primary symptom found in preeclampsia patients, along with protein in the urine. Prevention and detection efforts are essential to mitigate the impact of preeclampsia. This prevention must be comprehensive. Prevention of hypertension in early pregnancy is under-explored, despite being a necessary risk assessment[12]. The study found that 16.4% of mothers had preeclampsia. This figure is higher than the 5.3% preeclampsia rate in Indonesia[13].

Previous research suggests that the best diagnosis of hypertension in pregnancy is when systolic blood pressure is >20 mmHg, while an increase in diastolic blood pressure >20 mmHg has the best sensitivity and specificity (97.7%, 89.2%). For diastolic blood pressure, the best sensitivity and specificity are when diastolic blood pressure is >15 mmHg (92.3%, 92.3%)[14]. Paolino further said that systolic and diastolic blood pressure together were the best sensitivity and specificity assessments, with a predicted increase of > 20 mmHg in both (90.6%, 97.4%)[14]. Our research analysis, as shown in Table 3, found the best sensitivity and specificity for preeclampsia monitoring of systolic blood pressure at gestational age greater than 24 weeks (0.92%, 0.81), while diastolic blood pressure was higher at gestational age greater than 24 weeks (92%, 0.96). In addition to elevated systolic and diastolic blood pressure, gestational age also needs to be considered for early detection of preeclampsia. Elevated systolic and diastolic blood pressure >20 mmHg, as well as gestational age greater than 24 weeks, can increase the risk of preeclampsia. Although there is no reliable test in the first or second trimester of pregnancy to predict the development of preeclampsia, preeclampsia screening in the first trimester can be integrated into the health system. Furthermore, home BP monitoring is useful for chronic hypertension and sudden increases in BP (white-coat hypertension)[15].

MAP is one method of detecting hypertension. MAP has a significant influence on the occurrence of hypertension in pregnancy[16].In obstetrics, the MAP is determined at each prenatal visit. MAP is calculated by multiplying the diastolic value by 2, adding the systolic value, and dividing by 3. If the result is greater than 90 mmHg, the pregnant woman is categorized as being at moderate risk for preeclampsia[9]. Zulaeha's research found that MAP was significantly associated with preeclampsia and that the incidence of preeclampsia was more common with positive MAP at 28 weeks of gestation (78.1%) compared to 32 weeks or more of gestation (65.4%)[17]. MAP is a better predictor of preeclampsia in Asian women than several angiogenic factors. Furthermore, MAP screening is performed in the first and second trimesters[18]. Other studies have found a strong association between high MAP and the incidence of hypertension in the third trimester of pregnancy.[17]This is in line with WHO recommendations for monitoring MAP as a more sensitive predictive indicator than systolic and diastolic BP alone during pregnancy[16], [19]. Other studies have shown that engaging in good physical activity during pregnancy is correlated with lower MAP[20].

The optimal GWD range during pregnancy based on the International Organization of Medicine (IOM) recommendations for mothers with normal weight or with a Body Mass Index (BMI) of 18.5 – 24.9 is 25 to 35 lb or 11.33 to 15.87 kg, while for mothers with less weight it is 28-40 lb (12.7 – 18.1 kg) and more weight 15 - 25 lb (6.8 - 11.3 kg)[21]This recommendation is slightly lower than the Indonesian standard, which is 12.5–18 kg for underweight, 11.5–16 kg for normal BMI, 7–11.5 kg for overweight, and 5–9 kg for obesity.[9]Obesity is a high-risk factor for preeclampsia, causing an inflammatory

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response in adipose tissue. Underweight and appropriate weight gain reduce the incidence of preeclampsia, while excessive weight gain increases the risk. These results are consistent with previous research[12], [22]. Pregnant women with high GWD have an increased risk of preeclampsia (OR 2.154, 95%CI 1.353 – 3.429) compared to clients with adequate GWD (OR 0.894, 95%CI 0.691)[23]. If BMI and GWG are increased simultaneously, the risk of preeclampsia will increase[24].

Measuring body weight regularly is done as a precautionary measure for preeclampsia; besides being easy to do, it is also non-invasive.[25]. GWD during pregnancy is linear, and women with higher weight gain are at increased risk of preeclampsia[24], [26]. Another study found that weight gain in the hypertension group during pregnancy was 13.0 + 5 kg, while in the chronic hypertension group it was 10.6 + 3.4 kg.GWD during pregnancy was positively correlated with control blood pressure values (r=0.48; p=0.001) and maximum blood pressure (r=0.34; p=0.004). This study found that in women with chronic hypertension, greater weight gain during pregnancy than the benchmark was associated with blood pressure values in the third trimester[27]. Exercising during pregnancy can maintain health and an ideal weight and reduce the risk of hypertension[15].

Clinically, this study further emphasizes the importance of maternal blood pressure monitoring during pregnancy. Changes in systolic and diastolic BP, as well as MAP, are recorded serially, not at a single point in time. MAP monitoring is particularly suitable for resource-limited regions and developing countries.

This study still has limitations, including the data collected being secondary, resulting in uncontrolled examination procedures, such as the equipment used, measurement methods, and instrument validation. Meanwhile, weight gain was measured using average weight gain, not considering BMI as a benchmark for weight gain. This implies that an evaluation of the effectiveness of community-based screening in reducing the incidence of preeclampsia is needed.

CONCLUSION

The best sensitivity and specificity of blood pressure (systolic and diastolic) and MAP in pregnancies above 24 weeks obtained the best results, while weight gain was found to have a high sensitivity of 94% but a specificity of 0.15. From these results, it can be concluded that measuring systolic and diastolic blood pressure and assessing MAP can be used as a screening for preeclampsia in pregnant women.

Studies with a cohort perspective can be conducted to increase the validity of these findings, so that they can be used as a reference in policy making in detecting increased systolic and diastolic pressure and MAP as a severe risk of preeclampsia.

REFERENCES

[1] M. C. Honigberg *et al.*, "Polygenic prediction of preeclampsia and gestational hypertension," *Nat. Med.*, vol. 29, no. 6, pp. 1540–1549, 2023, doi: 10.1038/s41591-023-02374-9.Polygenic.

[2] L. Gao *et al.*, "Investigation of optimal gestational weight gain for twin pregnancy in Southwest China : a retrospective study," *Sci. Rep.*, vol. 13, no. 1, pp. 1–9, 2023, doi: 10.1038/s41598-023-31766-7.

[3] J. A. Hutcheon, R. W. Platt, B. Abrams, B. J. Braxter, K. P. Himes, and L. M. Bodnar, "Pregnancy weight gain by gestational age in women with uncomplicated dichorionic twin pregnancies," *Paediatr Perinat Epidemiol*, vol. 32, no. 2, pp. 172–180, 2019, doi: 10.1111/ppe.12446.Pregnancy.

[4] A. Werlang, A. Paquin, and T. Coutinho, "The EVA Study : Early Vascular Aging in Women With History of Preeclampsia," *J. Am. Heart Assoc.*, vol. 12, no. 8, pp. 1–24, 2023, doi: 10.1161/JAHA.122.028116.

[5] A. T. Tita *et al.*, "Treatment for Mild Chronic Hypertension during Pregnancy," *N. Engl.*

https://doi.org/10.34011/jmp2k.v35i4.4268

e-ISSN: 2338-3445
p-ISSN: 0853-9987

J. Med., vol. 386, no. 19, pp. 1781–1792, 2022.
[6] S. Koulouraki, V. Paschos, P. Pervanidou, P. Christopoulos, A. Gerede, and M. Eleftheriades, "Short- and Long-Term Outcomes of Preeclampsia in Offspring : Review of the Literature," *Child.*, vol. 10, no. 5, p. 826, 2023.
[7] V. Chu S.Y & D'Anggelo, D, "Gestational weight gain among US women who deliver twins, 2001-2006," *Am. J. Obstet. Gynecol.*, vol. 200, no. 390, pp. 391–396, 2009.
[8] M. C. Honigberg *et al.*, "Polygenic prediction of preeclampsia and gestational," *HHS public access PMC*, vol. 29, no. 6, pp. 1540–1549, 2023, doi: 10.1038/s41591-023-02374-9.Polygenic.
[9] Kemenkes RI, *Buku KIA (Kesehatan Ibu dan Anak)*. Indonesia: Kementrian Kesehatan RI, 2024.
[10] Dinas Kesehatan Kabupaten Kawarang, *Laporan SPM Bidang Kesehatan tahun 2024*. Karawang: Dinas Kesehatan Kabupaten Karawang, 2024.
[11] at all Cuningham, *Williams Obstetric*, 24th ed. Ney York: Mc Grow Hill Ecucation Medical, 2014.
[12] G. J. Burton, C. W. Redman, J. M. Roberts, and A. Moffett, "Pre-eclampsia : pathophysiology and clinical implications," *BMJ*, pp. 1–15, 2019, doi: 10.1136/bmj.l2381.
[13] K. T. Dewi, "Prevalence and Associated Factors of Severe Preeclampsia Among Pregnant Women," *Bull. Inspiring Dev. Achiev. Midwifery*, vol. 02, no. 1, pp. 35–43, 2025, doi: https://doi.org/10.69855/bidan.v2i1.152.
[14] S. X. .-G. Paulino Vigil de Gracia, O. Reyes-tejada, C. Mata, P. Asturizaga-soto, J. Collantes-cubas, and J. Cerrato-ferru, "Blood Pressure Changes in Adolescents with Preeclampsia : A Multicentre , Case-Control Study in Latin American Hospitals," *Soc. Obstet. Gynaecol. Canada*, vol. 43, no. 1, pp. 50–57, 2021.
[15] M. A. Brown *et al.*, "Hypertensive Disorders of Pregnancy ISSHP Classification, Diagnosis, and Management Recommendations for International Practice," *Hypertension*, vol. 72, no. 1, pp. 24–43, 2025, doi: 10.1161/HYPERTENSIONAHA.117.10803.
[16] N. U. R. Masruroh, A. Putro, and R. Santoso, "Hubungan Protein Urine Dan Mean Arterial Pressure Trimester Iii Di Rsu Prima Husada Sidoarjo," *J. Kebidanan Kestra*, vol. 3, no. 1, 2020.
[17] F. S. Zulaeha A Amdadi, Afriani, "Mean Arterial Pressure Dan Indeks Massa Tubuh Dengan Kejadian Preeklampsia Pada Ibu Hamil Di Rumah Sakit Bhayangkara Makasar," *Media Kesehat. Politek. Kesehat. Makassar*, vol. 15, no. 2, pp. 272–278, 2020.
[18] J. Zhu, J. Zhang, N. S. Razali, B. Chern, and K. H. Tan, "Mean arterial pressure for predicting preeclampsia in Asian women : a longitudinal cohort study," *BMJ Open*, vol. 11, no. 8, pp. 1–9, 2021, doi: 10.1136/bmjopen-2020-046161.
[19] WHO, *Prevention and treatment of pre-eclampsia and eclampsia*. Geneva: WHO, 2011.
[20] N. N. A. D. Sekarini, P. I. Pratiwi, N. K. Sulyastini, Y. Kurniawati, and I. A. K. T. Dwiyanti, "Mean Artery Pressure (MAP) dan Aktivitas Fisik pada Kehamilan," *Indones. Joutnal Midwifery*, vol. 7, no. 2, 2024.
[21] The American College of Obstetrician and Gynecology, "Weight Gain During Pregnancy," The American College of Obestetrician and Gynecologist, 2013, pp. 2009–2011.
[22] N. R. S. Minerva Riani Kadir, Herry Asnawi, "Hubungan Ukuran Lingkar Lengan Atas (LILA) dan Pertambahan Berat Badan selama Kehamilan dengan Berat Badan Lahir Bayi," *Sriwij. J. Med.*, vol. 2, no. 1, pp. 26–32, 2019.
[23] W. A. Iswari, A. Setyawan, and E. Armawan, "Gestational Weight Gain and Risk of Preeclampsia : A Case-Control Study Peningkatan Berat Badan saat Kehamilan dan Risiko Preeklamsia : Sebuah Studi Case-Control," *Indones. J. Obstet. Gynecol. Sci.*, vol. 7, no. 2, pp. 176–181, 2024.
[24] X. Gong, J. Li, Y. Jiang, and P. Yuan, "Risk of preeclampsia by gestational weight gain in women with varied prepregnancy BMI : A retrospective cohort study," *Front*

https://doi.org/10.34011/jmp2k.v35i4.4268

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Endocrinol, no. October, pp. 1–9, 2022, doi: 10.3389/fendo.2022.967102.

[25] B. M. Brumpton, S. Graham, I. Surakka, B. O. A, K. Hveem, and C. J. Willer, "Resource The HUNT study : A population-based cohort for genetic research ll The HUNT study : A population-based cohort for genetic research," *Cell Genom*, vol. 2, no. 10, p. 10093, 2022, doi: 10.1016/j.xgen.2022.100193.

[26] S. Santos, I. Eekhout, E. Voerman, and R. Gaillard, "Gestational weight gain charts for different body mass index groups for women in Europe, north America, and Oceania," *BMC Med.*, vol. 16, no. 1, p. 201, 2018.

[27] E. Szczerba, A. Zajkowska, K. Pankiewicz, G. Szewczyk, and G. Opolski, "Gestational Weight Gain And Blood Pressure Control In Physiological Pregnancy And Pregnancy Complicated," *J. mother child.*, vol. 26, no. 1, pp. 66–72, 2022, doi: 10.34763/jmotherandchild.20222601.d-22-00020.

https://doi.org/10.34011/jmp2k.v35i4.4268