The Association Between Preeclampsia and Low Birth Weight in Hospitals in Medan: A Case-Control Study

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Abstract

Preeclampsia is a medical condition that causes increased blood pressure occurring during pregnancy, which significantly contributes to poor prenatal outcomes, such as low birth weight (LBW). In Indonesia, especially in North Sumatra, the prevalence of preeclampsia remains significant; however, data concerning its correlation with low birth weight in hospital environments is still scarce. This research was intended to ascertain the correlation between preeclampsia and the incidence of low birth weight among mothers delivering in hospitals in Medan City. A hospital-based case–control study utilized secondary data from medical records at H. Adam Malik Hospital and Dr. Pirngadi Hospital, Medan, from January 2022 to June 2024. A total of 180 postpartum women participated, comprising 90 cases (women who gave birth to babies with low birth weight) and 90 controls (women who gave birth to babies with normal birth weight). We used multivariable logistic regression and chi-square testing to find adjusted odds ratios (ORs) with 95% confidence intervals (CIs). A strong link existed between low birth weight and preeclampsia. Mothers with preeclampsia exhibited a significantly elevated probability of delivering low birth weight infants in comparison to those without preeclampsia (adjusted OR = 6.21; 95% CI: 3.10–12.30; p < 0.001). Advanced maternal age (>35 years) and preterm gestational age (<37 weeks) were independently correlated with low birth weight (LBW), whereas parity exhibited no significant correlation. Preeclampsia is significantly correlated with the incidence of low birth weight in mothers delivering in hospitals in Medan City. To improve maternal and child health and lower the risk of bad outcomes for newborns, it is important to improve early detection and comprehensive antenatal management of preeclampsia.

Keywords: Preeclampsia, Low Birth Weight, Maternal Age, Gestational Age, Case-Control Study.

INTRODUCTION

Preeclampsia is a pregnancy condition that raises blood pressure and causes problems with organs. It usually happens after 20 weeks of pregnancy, and it is a major cause of disease and death in mothers and babies around the world. It is thought to affect about 2–8% of all pregnancies around the world (Vera-Ponce et al., 2025). The World Health Organization says that preeclampsia is a major cause of bad outcomes for mothers and babies, especially in places with few resources (World Health Organization, 2023). Research shows that hypertensive disorders of pregnancy, including but not limited to preeclampsia and eclampsia, continue to be significant contributors to maternal mortality in less developed regions such as Asia and Africa. Research shows that hypertensive disorders of pregnancy, like preeclampsia and eclampsia, are still major causes of maternal deaths in developing areas like Asia and Africa

(Jikamo et al., 2023). Preeclampsia affects about 2–8% of pregnancies around the world, and it causes about 10% of maternal deaths in Asia and Africa every year. According to data from the World Health Organization (World Health Organization, 2023), approximately 15% of maternal deaths are due to hypertensive disorders during pregnancy.

The situation in Asia differs from country to country. Data from Asia shows that the rate of pregnancy deaths caused by high blood pressure is about 2.1% in China, 1.2% in Japan, 2.2% in Thailand, and 0.6% in Nepal. This indicates that there are differences between regions that are attributed to factors such as population, nutrition, and the capacity of the health system in each region (Mou et al., 2021). Epidemiological data show that preeclampsia affects between 0.2% and 6.7% of people in Asia. Factors such as varying characteristics of the population and availability of health services can account for such variances (Chai et al., 2025). In fact, the Global Burden of Disease report of 2019 confirms that hypertensive disorders of pregnancy, such as preeclampsia, continue to affect low socioeconomic and health systems countries (Wang et al., 2021). In Indonesia, preeclampsia continues to be a significant contributor to maternal mortality in hospitals.Research shows that in the secondary and tertiary hospitals, the maternal mortality rate due to preeclampsia is 1.3% of the total number of cases treated (Aldika Akbar, Gumilar, Aziz, et al., 2025). The Indonesia Pre-eclampsia Study (INAPRES) found that the adverse effects on health of pre-eclampsia are very serious, with a maternal case fatality rate of approximately 2% and a perinatal mortality rate of about 12%. Field-based estimates indicate a wide range (3-10%) in prevalence across reports and are influenced by differences in methodology and population (Aldika Akbar, Gumilar, Pribadi, et al., 2025). Overall, it is thought that 5.3% of all pregnancies in Indonesia have preeclampsia, which is about 128,273 cases each year. Based on this information, we can say that preeclampsia is a major cause of death in pregnant women (Kunawati Tungga Dewi, 2025). In North Sumatra Province, data from the 2018 Riskesdas reported a prevalence of preeclampsia of about 2.7%. A recent study in Medan City showed that around 12.7% of pregnant women suffer from pregnancy-related hypertension, including preeclampsia (Nasution, 2025).

A single-center retrospective study of the Zero Mother Mortality Preeclampsia Program in Bandung, West Java, said that 9.8% of all deliveries from 2015 to 2022 had preeclampsia (Pribadi et al., 2023). Preeclampsia is related to many neonatal issues, including low birth weight, preterm birth, and intrauterine growth restriction (IUGR). These issues result from poor uteroplacental perfusion and nutrient transport to the fetus (Calek et al., 2024; Zuvarcan et al., 2024). In Medan, preeclampsia remains prevalent, especially among women aged 35 years and older. Preeclampsia increases the risk of IUGR, preterm birth, and subsequently, LBW.

Preeclampsia reduces the blood flow from the placenta to the uterus and compromises the fetus's access to critical oxygen and nutrients. This is related to poor placental perfusion and a fetus that is poorly oxygenated and nourished, increasing IUGR, preterm birth, and LBW (Indriany et al., 2024; Pietro et al., 2021; Reisman, 2024). Low birth weight (LBW) correlates with heightened neonatal morbidity and mortality, inhibits growth, compromises neurological development, and increases the risk of chronic disease in later life, thereby indicating substantial long-term effects on public health (World Health Organization, 2023). Therefore, understanding the correlation between preeclampsia and low birth weight (LBW) is crucial, not only to improve perinatal outcomes but also to broaden the overall understanding of maternal and child health. This study aims to ascertain the correlation between preeclampsia and the incidence of LBW among mothers delivering in hospitals in Medan City.

METHODS

This study used a case-control design to investigate the relationship between preeclampsia and LBW. This study was conducted at H. Adam Malik Hospital and Dr. Pirngadi Hospital in Medan, North Sumatra, Indonesia. The relevant information was obtained retrospectively from medical records of deliveries from January 2022 through June 2024. The study population comprised all mothers who delivered at the specified hospitals during the study period. There were 180 postpartum women in total, with 90 cases and 90 controls. The cases were considered to be mothers who gave birth to LBW babies; particularly, the cut-off point for baby birth weight was lower than 2500 grams. Control women were mothers who delivered normal-weight newborns (≥2,500 grams). Women were classified according to preeclampsia status during pregnancy.

Mothers were eligible if they delivered at one of the study hospitals from January 2022 to June 2024, had at least 20 weeks of gestation, and had complete medical records that included blood pressure, preeclampsia diagnosis, baby birth weight and gestational age, mothers' age, and number of previous births. Mothers were not included in the study if they had more than one pregnancy (twins or more), had high blood pressure before the pregnancy, had diabetes during the pregnancy, had chronic kidney disease, had severe systemic infections, or if the baby had major congenital anomalies. Medical records that were missing important information or had incomplete information were also not included.

The primary exposure variable was preeclampsia, defined by hypertension (systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg) that begins after 20 weeks of gestation, followed by proteinuria or other confirmed signs of maternal organ

dysfunction, as recorded in the medical records. The principal outcome variable was low birth weight, characterized as a baby's birth weight below 2,500 grams. Covariates encompassed mother age at delivery, classified as ≤ 35 years and > 35 years; gestational age at delivery, classified as < 37 weeks (preterm) and ≥ 37 weeks (term); and parity, classified as < 3 and ≥ 3 prior live deliveries. We used a standardized form to get the information from hospital medical records. The collected variables included maternal demographic characteristics, obstetric history, clinical diagnosis of preeclampsia, gestational age at delivery, and infant birth weight.

Statistical software was used to look at the data. Descriptive statistics were used to summarize the characteristics of the participants in the study. A bivariate analysis using the chi-square (χ^2) test was performed to assess the association between preeclampsia and low birth weight, as well as the association between covariates and low birth weight. In the bivariate analysis, variables with p-values < 0.25 were included in a multivariate logistic regression model to identify independent predictors of low birth weight and to account for confounding variables. We used odds ratios (ORs) and 95% confidence intervals (CIs) to indicate the strength of the associations. A p-value less than 0.05 was considered statistically significant. This research was conducted in accordance with the tenets of the Declaration of Helsinki. The institutional ethics committee of the Faculty of Medicine at Universitas Muhammadiyah North Sumatra gave its permission for the study. Anonymized data collected solely for research purposes was used to protect patient information.

RESULT

The study examines 180 postpartum mothers: 90 cases (women who gave birth to babies with low birth weight) and 90 controls (women who gave birth to babies with normal birth weight). All subjects, recruited from H. Adam Malik Hospital and Dr. Pirngadi Hospital in Medan, delivered their babies from January 2022 to June 2024. A statistically significant association between preeclampsia and low birth weight was found in bivariate analysis using the chi-square (χ^2) test. Mothers who had preeclampsia were significantly more likely to deliver neonates with low birth weight than those who did not have preeclampsia (p = 0.001).

Maternal age and gestational age were also strongly linked with low birth weight. Mothers aged 35 years or older had a higher proportion of low-birth-weight infants than those aged 35 years or younger (p = 0.003). In addition, deliveries occurring before 37 weeks of gestation were significantly associated with low birth weight (p = 0.001). Parity was not strongly linked with low birth weight in the bivariate analysis (p > 0.05).

Table 1. Relationship Between Preeclampsia and the Occurrence of LBW

Variable	Lbw		Normal birth weight		Total	OR (95% CI)	p-value
	n	(%)	n	(%)			
Pre eclampsia	68	75.6	22	24.4	90	6.21 (3.1-12.3)	0.001
Non - pre eclampsia	22	24.4	68	75.6	90	-	-

We also looked at other factors that might be related to LBW, such as the mother's and baby's ages at birth. The results indicated that maternal age >35 years and gestational age <37 weeks were significantly associated with LBW.

Table 2. The Correlation Between Maternal Age and Gestational Age With LBW

Risk Factors	Category	LBW		Normal Birth Weight		OR (95% CI)	p-value
		n	(%)	n	(%)		
Maternal Age	> 35 years	45	64.3	25	35.7	2.85 (1.4 – 5.7)	0.003
Maternal Age	≤ 35 years	45	33.3	90	66.7	Ref	-
Gestational Age	< 37 weeks	56	77.8	16	22.2	4.9 (2.2 -10.8)	0.001
Gestational Age	≥ 37 weeks	34	28.3	86	71.7	Ref	-

Multivariate logistic regression was used to identify independent predictors of low birth weight and to control for variables that might have affected the results. The model incorporated variables such as preeclampsia, maternal age, gestational age, and parity.

The multivariate analysis indicated that preeclampsia was the most significant independent predictor of low birth weight. Mothers with preeclampsia were over six times more likely to give birth to infants with low birth weight compared to those without the condition (OR = 6.21; 95% CI: 3.10–12.30; p = 0.001). Maternal age over 35 years was also independently associated with low birth weight (OR = 2.85; p = 0.003). Gestational age of less than 37 weeks was significantly associated with an increased odds of low birth weight (p = 0.001). Parity of three or more births was not strongly linked with low birth weight after adjustment for other variables (p = 0.165).

Table 3. Multivariate Logistic Regression Analysis

Variable	β	SE	OR (95% CI)	p-value
Preeclampsia	1.83	0.46	6.21 (3.1-12.30)	0.001
Maternal Age > 35 years	1.04	0.35	2.83 (1.4-5.7)	0.003
Gestational Age < 37 weeks	1.58	0.44	4.87 (2.2-10.8)	0.001
Parity ≥ 3	0.32	0.28	1.38 (0.8-2.3)	0.165

DISCUSSION

This study shows a strong link between preeclampsia and low birth weight (LBW) in mothers who gave birth at referral hospitals in Medan. Mothers with preeclampsia are more than six times as likely to have children born with low birth weight compared to mothers without preeclampsia. These results are consistent with the latest national and international studies showing a significant connection between hypertensive diseases during pregnancy and adverse neonatal outcomes such as low birth weight (LBW) (Jung et al., 2022; Lieskusumastuti et al., 2022; Zuvarcan et al., 2024).

Data from Indonesia over the last five years supports the results of the current study. A hospital-based case-control study in Central Java indicated a strong association between preeclampsia and low birth weight (LBW) after controlling for gestational age and maternal characteristics (OR = 2.11) (Khayati & Regita, 2025). A retrospective study in East Java identified preeclampsia and preterm birth as independent predictors of low birth weight (LBW), with preeclampsia retaining significance in multivariate analysis (Dzakiyyah et al., 2025). These results show that the association of preeclampsia with LBW is evident in various parts of Indonesia.

The problems associated with the remodelling of the uteroplacental circulation that cause placental ischemia due to insufficient flow, as well as difficulty in the delivery of nourishment and oxygen to the baby, are what cause the problems associated with preeclampsia. Maladaptation of placental function and endothelial function is closely associated with fetal growth restriction and, ultimately, low birth weight. (Sławek-Szmyt et al., 2022; Tsikouras et al., 2024). Rana et al. (2019) also pointed out that placental hypoperfusion and endothelial dysfunction, which are common in preeclampsia, are also linked to poor fetal growth. We can't say for sure that one thing causes another based on observational designs, but the fact that the associations are the same across different groups makes this relationship more likely (Rana et al., 2019). From a biological perspective, these mechanisms reduce the delivery of nutrients and oxygen to the fetus, leading to IUGR and lower birth weight in neonates. Thus, the findings of this study confirm previously established knowledge of the pathophysiology of preeclampsia and its impact on perinatal outcomes. These mechanisms are the same as those related to reduced oxygen and nutrient transfer to the fetus, which may cause IUGR and reduced birth weight (Rana et al., 2019). The outcomes of this study are therefore biologically plausible and aligned with current pathophysiological understanding.

In this study, an independent association between maternal age > 35 years and low birth weight (LBW) was observed. Increased maternal age is linked to a higher chance of pregnancy-

related problems such as hypertensive disorders and placental insufficiency, which might have secondary effects on fetal growth. While maternal age reflects an established risk for LBW, some studies have suggested that the impact of maternal age may be modified or confounded by other obstetric factors. Although maternal age has been widely studied as something that can cause low birth weight, evidence suggests that its influence may be modified or confounded by other obstetric variables. For instance, large population-based register studies show that the association between advanced maternal age and LBW can diminish when adjusting for parity, gestational age, and familial factors (Aradhya et al., 2022). Similarly, gestational age may mask the direct relationship between maternal age and birth weight, proving that age alone is not always a direct determinant (Huang et al., 2025). Additionally, some hospital-based studies report no significant independent association between maternal age categories and LBW after multivariable adjustment (Candijaya et al., 2021).

As with national and international evidence identifying prematurity as a significant factor in low birth weight (LBW), a gestational age of less than 37 weeks was significantly correlated with LBW (World Health Organization, 2023). The persistence of this association post-adjustment highlights the importance of gestational age as a covariate in the analysis of birth weight.

When multiple factors were considered, parity was not found to be independently associated with low birth weight (LBW). This finding indicates that, within this study population, maternal health conditions and gestational factors have a greater impact on birth weight than reproductive history alone, aligning with results from other Indonesian hospital-based studies. It is worth noting a few limitations. The case–control design does not allow for causal inference or estimation of incidence. Furthermore, the utilization of secondary data from medical records may be influenced by information bias and residual confounding arising from unmeasured variables, including maternal nutritional status, socioeconomic conditions, and the quality of antenatal care. Despite these limitations, this study provides significant insights into the correlation between pre-eclampsia and LBW in a tertiary hospital setting in Indonesia. The results underscore the significance of prompt identification and vigilant monitoring of pregnant women with preeclampsia to alleviate negative neonatal outcomes.

CONCLUSION

Preeclampsia is correlated with giving birth to babies with low birth weight by mothers who gave birth at referral hospitals in Medan. The likelihood of having a baby with an LBW was higher among mothers with preeclampsia in comparison with mothers who did not have

preeclampsia. A maternal age exceeding 35 years and a gestational age of under 37 weeks were independently correlated with low birth weight. While causal inference is not ascertainable due to the case–control design, the results align with contemporary international and national evidence and are biologically plausible based on the current comprehension of placental dysfunction in preeclampsia. This justifies the need to detect preeclampsia cases early and supervise and manage preeclampsia cases through good antenatal care to avoid bad outcomes for the babies. For future studies, the authors suggest a prospective cohort design with additional maternal and fetal variables to better explain the relationship between preeclampsia and low birth weight in the Indonesian setting.

REFERENCES

Aldika Akbar, M. I., Gumilar, K. E., Aziz, M. A., Pribadi, A., Bachnas, M. A., Aryanda, R. A., & Dekker, G. (2025). Maternal death associated with preeclampsia in Indonesia. *Pregnancy Hypertension*, *42*, 101400. https://doi.org/10.1016/j.preghy.2025.101400

Aldika Akbar, M. I., Gumilar, K. E., Pribadi, A., Aziz, M. A., Ernawati, E., Wardhana, M. P., Sulistyono, A., Bachnas, M. A., Irwinda, R., Rahardjo, B., Aditiawarman, Hamid, A. R. H., Dewantiningrum, J., Prasetyadi, F. O. H., Darus, F., Ditya, A., Djuanda, J. K., Putri, R. W. R., Satriadi, T. T., … Aryananda, R. A. (2025). The Indonesia pre-eclampsia study (INAPRES): Pregnancy outcomes in pregnancy with pre-eclampsia in Indonesia. *International Journal of Gynecology & Obstetrics*, *n/a*(n/a). https://doi.org/10.1002/ijgo.70587

Aradhya, S., Tegunimataka, A., Kravdal, Ø., Martikainen, P., Myrskylä, M., Barclay, K., & Goisis, A. (2022). Maternal age and the risk of low birthweight and pre-term delivery: A pan-Nordic comparison. *International Journal of Epidemiology*, *52*(1), 156–164. https://doi.org/10.1093/ije/dyac211

Calek, E., Binder, J., Palmrich, P., Eibensteiner, F., Thajer, A., Harreiter, K., Berger, A., & Binder, C. (2024). Preeclampsia and Future Implications on Growth and Body Composition in Preterm Infants. *Nutrients*, *16*(21), 3627. https://doi.org/10.3390/nu16213627

Candijaya, G. S., Mardjuki, E., & Surjono, E. (2021). Role of Maternal Factors in Low Birth Weight: *Indonesian Journal of Obstetrics and Gynecology*, 186–191. https://doi.org/10.32771/inajog.v9i4.1513

Chai, L., Li, S., Yin, B., Zhu, X., Zhu, B., & Wu, K. (2025). Prevalence, risk factors, and adverse perinatal outcomes in Chinese women with preeclampsia: A large retrospective cohort study. *Journal of Health, Population and Nutrition*, *44*(1), 32. https://doi.org/10.1186/s41043-025-00778-6

Dzakiyyah, S. A., Rahma, A., Salsabila, A., Agustina, D. S., Qamariah, S., Duarsa, A. M., & Cininta, N. I. (2025). Preeclampsia And Preterm Birth As Predominant Factors Of Low Birth Weight: Insights From A Rural Hospital In Indonesia. *Folia Medica Indonesiana*, *61*(2), 196–203. https://doi.org/10.65346/2599-056X.2404

Huang, Z., Zhang, Y., Wang, J., Tan, X., & Zhang, A. (2025). Impact of maternal age on birth weight-related adverse outcomes in newborns: A retrospective study in south-central China. *BMC Pregnancy and Childbirth*, *25*, 92. https://doi.org/10.1186/s12884-025-07199-7

Indriany, D. S., Yorita, E., Ekanugraheni, D., & Yanniarti, S. (2024). Preeclampsia is a risk

factor for Low Birth Weight (LBW) infants. *JNKI (Jurnal Ners Dan Kebidanan Indonesia) (Indonesian Journal of Nursing and Midwifery)*, *12*(2), 151–167. https://doi.org/10.21927/jnki.2024.12(2).151-167

Jikamo, B., Adefris, M., Azale, T., & Alemu, K. (2023). Incidence, trends and risk factors of preeclampsia in sub-Saharan Africa: A systematic review and meta-analysis. *PAMJ - One Health*, *11*. https://doi.org/10.11604/pamj-oh.2023.11.1.39297

Jung, E., Romero, R., Yeo, L., Gomez-Lopez, N., Chaemsaithong, P., Jaovisidha, A., Gotsch, F., & Erez, O. (2022). The etiology of preeclampsia. *American Journal of Obstetrics & Gynecology*, *226*(2), S844–S866. https://doi.org/10.1016/j.ajog.2021.11.1356

Khayati, Y. N., & Regita, A. (2025). Preeclampsia Increases the Risk of Low Birth Weight, Case-Control Study at Gondo Suwarno Ungaran Hospital. *Proceedings of International Conference on Health Science, Practice, and Education*, 920–928. https://doi.org/10.15294/icohespe.2025.4166

Kunawati Tungga Dewi. (2025). Prevalence and Associated Factors of Severe Preeclampsia Among Pregnant Women. *Bulletin of Inspiring Developments and Achievements in Midwifery*, *2*(1), 36–44. https://doi.org/10.69855/bidan.v2i1.152

Lieskusumastuti, A. D., Setyorini, C., Hanifah, L., & Hapsari, I. A. (2022). Hubungan Preeklamsia Dengan Kejadian Berat Badan Lahir Rendah (BBLR) Pada Ibu Bersalin di RS PKU Muhammadiyah Delanggu. *Jurnal Kebidanan Indonesia*, *14*(1), 139–147. https://doi.org/10.36419/jki.v14i1.770

Mou, A. D., Barman, Z., Hasan, M., Miah, R., Hafsa, J. M., Das Trisha, A., & Ali, N. (2021). Prevalence of preeclampsia and the associated risk factors among pregnant women in Bangladesh. *Scientific Reports*, *11*, 21339. https://doi.org/10.1038/s41598-021-00839-w

Nasution, S. S. (2025). The Relationship Between the Behaviour of Pregnant Women in Recognising Pregnancy Hypertension and Preeclampsia Incidence in Medan Community Health Centre. *Caring: Indonesian Journal of Nursing Science*, *7*(2), 277–282. https://doi.org/10.32734/ijns.v7i2.22410

Pietro, L., Guida, J. P. D. S., Nobrega, G. D. M., Antolini-Tavares, A., & Costa, M. L. (2021). Placental Findings in Preterm and Term Preeclampsia: An Integrative Review of the Literature. *Revista Brasileira de Ginecologia e Obstetrícia / RBGO Gynecology and Obstetrics*, *43*(07), 560–569. https://doi.org/10.1055/s-0041-1730292

Pribadi, A., Hidayat, D., Sasotya, R. M. S., Aziz, M. A., Nurdiawan, W., Pramatirta, A. Y., Siddiq, A., Mose, J. C., Hidayat, Y. M., Nugrahani, A. D., Santoso, D. P. J., & Permadi, W. (2023). Assessing the Impact of the Zero Mother Mortality Preeclampsia Program on Maternal Mortality Rates at a Single Center in Bandung, West Java (2015–2022): A Retrospective Study. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, *29*, e941097-1-e941097-6. https://doi.org/10.12659/MSM.941097

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

Reisman, J. (2024). Impact of Vascular Alterations on Maternal and Fetal Outcomes in Preeclampsia. *Clinics Mother Child Healt*, *21*(0). https://doi.org/10.35248/2090-7214.21.S27.005

Sławek-Szmyt, S., Kawka-Paciorkowska, K., Ciepłucha, A., Lesiak, M., & Ropacka-Lesiak, M. (2022). Preeclampsia and Fetal Growth Restriction as Risk Factors of Future Maternal Cardiovascular Disease—A Review. *Journal of Clinical Medicine*, *11*(20), 6048. https://doi.org/10.3390/jcm11206048

Sun, S., Li, W., Zhang, X., Aziz, A. ur R., & Zhang, N. (2025). Trends in global and regional incidence and prevalence of hypertensive disordersin pregnancy (1990–2021): An age-

period-cohort analysis. *Scientific Reports*, *15*, 1513. https://doi.org/10.1038/s41598-025-85819-0

Tsikouras, P., Antsaklis, P., Nikolettos, K., Kotanidou, S., Kritsotaki, N., Bothou, A., Andreou, S., Nalmpanti, T., Chalkia, K., Spanakis, V., Iatrakis, G., & Nikolettos, N. (2024). Diagnosis, Prevention, and Management of Fetal Growth Restriction (FGR). *Journal of Personalized Medicine*, *14*(7). https://doi.org/10.3390/jpm14070698

Vera-Ponce, V. J., Loayza-Castro, J. A., Ballena-Caicedo, J., Valladolid-Sandoval, L. A. M., Zuzunaga-Montoya, F. E., & Gutierrez De Carrillo, C. I. (2025). Global prevalence of preeclampsia, eclampsia, and HELLP syndrome: A systematic review and meta-analysis. *Frontiers in Reproductive Health*, *7*, 1706009. https://doi.org/10.3389/frph.2025.1706009

Wang, W., Xie, X., Yuan, T., Wang, Y., Zhao, F., Zhou, Z., & Zhang, H. (2021). Epidemiological trends of maternal hypertensive disorders of pregnancy at the global, regional, and national levels: A population-based study. *BMC Pregnancy and Childbirth*, *21*(1), 364. https://doi.org/10.1186/s12884-021-03809-2

World Health Organization. (2023). *Pre-eclampsia*. https://www.who.int/news-room/fact-sheets/detail/pre-eclampsia

Zuvarcan, D. A., Putra, D. A., & Martuti, S. (2024). Correlation between Preeclampsia and Infant Low Birth Weight at Dr. Moewardi Hospital, Surakarta, Central Java, Indonesia. *Journal of Maternal and Child Health*, *9*(1), 28–37. https://doi.org/10.26911/thejmch.2024.09.01.03