Contents lists available at IOCS

Science Midwifery

journal homepage: www.midwifery.iocspublisher.org

Analysis of factors associated with the onset of preeclampsia in pregnant women in Kotabaru District, South Kalimantan Province

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ARTICLE INFO

Article history:

Received Apr 9, 2025
Revised Apr 17, 2025
Accepted Apr 24, 2025

Keywords:

BMI
Multiple Pregnancy
Onset
Parity
Preeclampsia

ABSTRACT

Background: South Kalimantan with an MMR of 145 deaths per 100,000 KH. The number of maternal deaths due to preeclampsia is 10 cases. Kotabaru with the second highest number of maternal deaths with a total of 14 cases and there were 6 cases in 2023. Early-onset preeclampsia is preeclampsia that occurs before 34 weeks of gestation and late-onset preeclampsia. The aim of the study was to analyse the correlation of risk factors with the onset of preeclampsia in pregnant women in Kotabaru District. Research Methods: Analytical observational research with cross sectional research design after obtaining approval from the ethics commission of Stikes Guna Bangsa Yogjakarta No. 023/KEPK/IX/2024. All preeclampsia pregnant women in 2023 as many as 148 preeclampsia pregnant women's data were taken and recorded, then chi squared analysis and multiple logistic regression were carried out. Results: The results showed there was an association between parity (p value = 0.001), BMI (p value = 0.017), multiple pregnancy (p value = 0, 025) with the onset of preeclampsia. The results of multiple logistic regression analysis showed the variable parity p value = 0.001 and Exp B (3, 975) and 95% CI 1.811 - 8.401 is the most dominant factor associated with the onset of preeclampsia. Conclusion: There is an association between parity, BMI, and multiple pregnancy with the onset of preeclampsia. The most dominant factor associated is parity. The implications of the research results are that the community is more active in participating in maternal and child health programs, and disseminating information about preeclampsia to other pregnant women, providing iron-enriching and providing calcium tablets to mothers from the first trimester of pregnancy if they are anemic, integrated ANC services.

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INTRODUCTION

The (WHO, 2025), through the Sustainable Development Goals (SDGs), aims to enhance maternal health. Collaborating countries focus on reducing maternal morbidity and mortality (MMR) globally, targeting a reduction to 70 per 100,000 live births by 2030. In Southeast Asia, most maternal deaths occur in developing nations, with Indonesia ranking third in maternal mortality cases within the region (Syairaji et al., 2024)(Soultoni Akbar et al., 2022). According to the Maternal Perinatal Death Notification (MPDN) in 2023, maternal deaths increased from 4,005 in 2022 to 4,129 in 2023.

South Kalimantan reported an MMR of 145 deaths per 100,000 live births, with preeclampsia accounting for 10 cases, hemorrhage for 8 cases, infection for 1 case, and other obstetric and non-obstetric complications for the remaining cases (Profil Dinas Kesehatan Kalimantan Selatan, 2024).

Kotabaru, the largest district in South Kalimantan (9,422.46 km² or 25.11% of the province's area), recorded the second-highest maternal mortality rate in the province, with 14 deaths in 2023. Six of these were attributed to preeclampsia (Profil Dinas Kesehatan Kabupaten Kotabaru, 2023). The district's diverse geography, including urban areas, plantations, industrial zones, mountains, islands, beaches, and lowlands, presents significant challenges in delivering adequate healthcare services, including care for preeclampsia cases.

The main obstacle that occurs in handling preeclampsia currently is that to obtain aspirin for mothers at risk of preeclampsia, they must be referred to the hospital because the health center does not have aspirin available and there is no pharmacy in the sub-district area. Preeclampsia is a common pregnancy complication, with a prevalence of 2–15% of all pregnancies. Defined as gestational hypertension after 20 weeks of pregnancy, accompanied by proteinuria or edema and specific organ dysfunction, it poses severe risks to both mother and fetus (Cheng et al., 2023).

Early-onset preeclampsia occurs before 34 weeks of gestation, often linked to impaired placental implantation and remodeling of spiral arteries, resulting in placental dysfunction. Late-onset preeclampsia, developing after 34 weeks, is associated with maternal risk factors like obesity, diabetes, and chronic hypertension. Late-onset cases generally show milder symptoms and increased systemic inflammation (ACOG Practice Bulletin, 2020). Current strategies emphasize prevention, early diagnosis, and care stratification, such as administering low-dose aspirin to high-risk pregnant women and optimizing delivery timing (Chappell et al., 2021).

Risk factors include maternal age extremes, nulliparity, obesity, diabetes, chronic hypertension, renal disease, family history of preeclampsia, socioeconomic disparities, and autoimmune disorders (Alanazi et al., 2022; Paré et al., 2014).

Mapping studies identified inconsistent findings regarding parity, BMI >30, and multiple pregnancies within the last five years. Studies reveal a direct correlation between BMI and preeclampsia risk. Overweight mothers (BMI 26 kg/m²) are twice as likely, and obese mothers (BMI 30 kg/m²) nearly three times as likely, to develop preeclampsia (Abraham & Romani, 2022). Immune tolerance issues and maternal-fetal genetic differences further contribute to the risk (Dana et al., 2024).

Research shows high parity, multiple pregnancies, and obesity as significant contributors to preeclampsia. Targeted interventions, education, and lifestyle modifications can mitigate risks, improve early detection, and optimize pregnancy. Wide geographical (9,422.46km) more than a quarter of South Kalimantan, far access to get advanced services. Sea routes that do not operate every day, making it difficult for patients to get advanced services at the hospital, if the sub-district must go through the sea. This study needs to be done because of the increase in cases of death due to Preeclampsia (of 14 cases of maternal death, 6 of them were Preeclampsia) due to inadequate health services.

RESEARCH METHOD

This study was conducted as an analytical observational study using a retrospective cross-sectional approach. Researchers observed and analyzed data collected from the study subjects without providing interventions or specific treatments. The observation focused on the variables of parity, body mass index (BMI), and multiple pregnancies at a specific point in the past, namely in 2023. The population of this study consisted of pregnant women with preeclampsia in 2023 who sought medical care in Kotabaru District, South Kalimantan Province. The sample included 148 preeclamptic pregnant women from 2023 in the same region.

The inclusion criteria for this study were pregnant women with a gestational age of over 20 weeks and experiencing preeclampsia, complete identity data in the KIA room of the Dirgahayu Health Center, Kotabaru Regency. The sampling technique employed was total sampling. Data were obtained from medical records and maternal and child health (KIA) registers in healthcare service areas for maternal and child health, as well as the medical records department of local public health centers (Puskesmas). Data collection was facilitated by coordinative midwives from 28 Puskesmas in Kotabaru District. Data checking is carried out repeatedly by enumerators and researchers to ensure valid data.

In the data collection process before starting data collection, researchers carry out a common perception with enumerators via zoom, starting from operational definitions, data collection methods, data validation, and rechecking, and researchers always communicate with the TEAM regarding all obstacles and achievements of the data obtained. The research was conducted from September 20 to October 10, 2024.

RESULTS AND DISCUSSIONS

Table 1. Frequency distribution of pregnant women with preeclampsia at community health centers in Kotabaru Regency in 2023

Characteristics	Preeclmasia			
	Early Onset		Late Onset	
	n	%	n	%
Age				
At Risk	53	57,6	28	50,0
Not At Risk	39	42,4	46	50,0
Mother's Occupation				
Housewife	78	84,8	42	75,0
Trader	3	3,3	2	3,6
PNS	5	5,5	6	10,7
Self-Employed	1	1,1	1	1,8
Village Official	-	-	1	1,8
Employee	4	4,3	1	1,8
Honorary	1	1,1	3	5,4
Body Mass Index				
Obesity	25	27,2	6	10,7
Not Obese	67	72,8	50	89,3
Parity				
At Risk	51	55,4	15	26,8
Not At Risk	41	44,6	41	73,2

Table 2. Frequency distribution of age and parity in the multiple and single pregnancy at Community Health Centers in Kotabaru Regency in 2023

Characteristics	Pregnancy			
	Multiple		Single	
	n	%	n	%
Age				
At Risk	6	4,8	67	45,2

Characteristics	Pregnancy			
	Multiple		Single	
	n	%	n	%
Not At Risk	2	1	73	49
Parity				
At Risk	4	2,7	62	41,8
Not At Risk	4	2,7	78	52,7

Table 3. Factors associated with the onset of preeclampsia in pregnant women in Kotabaru Regency in 2023

Variable	Value p< 0,25		Description
Parity	0,001	< 0,025	Included in the model
IMT	0,017	< 0,025	Included in the model
Multiple Pregnancy	0,025	≥ 0,025	Not Included in the model

Table 3. Multivariate logistic regression model of the onset of preeclampsia in pregnant women in Kotabaru Regency in 2023

Independent Variable	Value P	Exp (B)	CI 95 %	
			Lower	Upper
Parity	0,001	3,975	1,881	8,401
IMT	0,007	3,988	1,458	10,910

Women who are pregnant at the age of over 35 years have a higher risk of early-onset preeclampsia. The aging process can cause changes in blood vessels, increasing the risk of hypertension and endothelial dysfunction. The prevalence of chronic medical conditions such as hypertension, diabetes, and obesity increases with age, all of which are risk factors for preeclampsia. The immune system changes with age and can affect immunological tolerance to pregnancy (Cornelius, 2018). Early-onset preeclampsia has a worse prognosis compared to late-onset preeclampsia, due to the fact that the mother's body cannot compensate for the metabolic and physiological changes caused by preeclampsia over a prolonged period. Early-onset preeclampsia is often associated with more severe conditions due to more complex pathological changes and more serious organ dysfunctions (Shaikh et al., 2021).

Multiple pregnancies involve greater cardiovascular changes, with the number of fetuses exceeding one, which can worsen the physiological response of the mother to pregnancy. Women with twin pregnancies have larger placentas, which can lead to reduced perfusion of the placenta. Excessive placental tissue is unlikely to receive adequate perfusion compared to women with singleton pregnancies, thus increasing the risk of preeclampsia. Therefore, women with multiple pregnancies require special attention and strict monitoring during pregnancy (Parantika et al., 2021). In multiple pregnancies, there is a significant increase in placental mass. This can cause failure in the adequate remodeling of uterine spiral arteries, resulting in suboptimal placental perfusion (Fox et al., 2014). Multiple pregnancies are characterized by a substantial increase in placental mass. This larger placental mass requires more extensive uterine vascular remodeling to ensure adequate perfusion. However, failure often occurs in the remodeling process of the spiral arteries, leading to suboptimal placental perfusion and placental hypoxia. Multiple pregnancies trigger a more intense inflammatory response compared to singleton pregnancies, as increased pro-inflammatory cytokines and complement system activation play a role in the pathogenesis of early-onset preeclampsia (Cheng et al., 2023).

The combination of these factors leads to systemic endothelial dysfunction, vasoconstriction, and target organ damage, ultimately resulting in the clinical manifestations of early-onset preeclampsia in multiple pregnancies. Screening for preeclampsia risk factors should be carried out comprehensively in at-risk age groups, specifically pregnant women under 20 years old and over 35 years old. For younger pregnant women (<20 years), screening emphasizes the evaluation of reproductive system maturity, nutritional status, and access to prenatal healthcare services, as this group is often associated with less favorable socio-economic status. Meanwhile, for

older pregnant women (>35 years), screening focuses on the early detection of chronic medical conditions such as hypertension, diabetes, and obesity, as well as endothelial and cardiovascular function assessments, which may be impaired due to the aging process, potentially increasing the risk of preeclampsia. Women with twin and singleton pregnancies have equal access to prenatal services.

Housewives bear dual responsibilities in managing the household and raising children, combined with the potential for social isolation, which can create a chronic stress environment. Prolonged stress activates the sympathetic nervous system and increases the production of stress hormones such as cortisol. Increased cortisol has been linked to endothelial dysfunction and increased vascular resistance, both of which are key characteristics in the pathophysiology of preeclampsia (Fadli, 2019). A lack of physical activity among housewives also contributes to an increased risk of preeclampsia. A sedentary lifestyle can lead to obesity and insulin resistance, both of which are risk factors for preeclampsia. Research shows that moderate physical activity during pregnancy can improve endothelial function and insulin sensitivity, potentially reducing the risk of preeclampsia (Syahadatina et al., 2021).

Nutritional aspects play an important role in the development of preeclampsia. A lack of nutritional knowledge or access to nutritious food among housewives can lead to nutritional imbalances. Deficiencies in micronutrients such as calcium, magnesium, and antioxidants have been associated with an increased risk of preeclampsia. Environmental exposure is a particular concern for housewives. Routine use of household cleaning products and exposure to indoor air pollutants can affect placental function (Mazumder et al., 2024).

Socioeconomic factors have a multidimensional influence on the risk of preeclampsia. Lower socioeconomic status is often linked to limited access to quality prenatal care and health education. Epidemiological studies show an inverse correlation between socioeconomic status and the incidence of preeclampsia, emphasizing the importance of social factors in maternal health. A lack of social support is a frequently overlooked risk factor. Social isolation can reduce emotional and practical support, which is crucial during pregnancy (Fatimah & Nuryaningsih, 2018).

In nulliparous women, the immaturity of the maternal immune system against paternal antigens is a key factor in the placentation process. The maternal immune system fails to establish appropriate tolerance to the fetoplacental unit. This leads to inadequate trophoblast invasion into maternal spiral arteries, which plays a crucial role in ensuring adequate blood supply for fetal development. In grandmultiparous women, repeated pregnancies lead to chronic endothelial dysfunction. Structural changes in the uterine blood vessels and a decreased capacity for vascular remodeling contribute to disturbances in the placentation process. This condition increases the risk of preeclampsia (Tarigan & Yulia, 2021). The relationship between parity and the onset of preeclampsia is important to understand, as it can influence strategies for prevention and pregnancy management. A study by wahyuni, shows that early intervention can reduce the risk of preeclampsia in women with at-risk parity, highlighting the importance of more comprehensive screening in this group. Thus, closer monitoring of pregnant women with at-risk parity can be an effective preventive step (Wahyuni, 2024).

Pregnant women with obesity experience a combination of metabolic and vascular factors that accelerate the onset of preeclampsia symptoms early in pregnancy. Research also shows that obesity increases the risk of an imbalance between the demand and supply of oxygen to the placenta, which can trigger the development of early-onset preeclampsia. On the other hand, late-onset preeclampsia, which occurs after 34 weeks of pregnancy, is more commonly associated with other mechanisms, such as chronic hypertension or less significant weight gain during pregnancy. However, the incidence of late-onset preeclampsia is lower compared to early-onset preeclampsia in obese women. Nonetheless, it remains important to conduct routine monitoring because this condition can also cause complications for both the mother and fetus. Overall, these findings emphasize the importance of close monitoring in obese pregnant women to detect early signs of

preeclampsia, particularly early-onset preeclampsia, which occurs more frequently in this group. Efforts to manage weight before pregnancy are also important as a preventive measure to reduce the risk of preeclampsia and other related complications (Poniedziałek-Czajkowska et al., 2023). This is in line with research by (Lopez-Jaramillo et al., 2018) which states that in pregnant women who are overweight, obesity can lead to preeclampsia through mechanisms such as hyperleptinemia, metabolic syndrome, inflammatory reactions, and increased oxidative stress, which ultimately leads to endothelial damage and dysfunction (Lushinta et al., 2022).

Researchers assume that the factors contributing to the higher risk in multiple pregnancies are the increased hemodynamic load (blood flow) and higher pressure on the maternal circulatory system compared to singleton pregnancies. Women with multiple pregnancies have a larger placental volume and increased circulatory needs, which can trigger vascular dysfunction and lead to early-onset preeclampsia. This condition is often accompanied by a sudden increase in blood pressure and a decline in maternal organ function, especially in the kidneys and liver. Moreover, the maternal body's adaptation mechanisms to pregnancy stress are not strong enough in multiple pregnancies, increasing the risk of early-onset preeclampsia. The absence of late-onset preeclampsia in this group could be due to the fact that late-onset preeclampsia is more often associated with singleton pregnancies, where complications are milder and develop in the later stages of pregnancy. Therefore, the increased prevalence of early-onset preeclampsia in multiple pregnancies underscores the importance of close monitoring during pregnancy, particularly to detect early signs of preeclampsia and mitigate the risk of serious complications for both the mother and the baby (Rahayu, 2023).

Incomplete trophoblastic invasion is likely to occur in early-onset preeclampsia with a gestational age under 34 weeks. Shallow trophoblastic invasion causes endovascular trophoblasts to cover the decidual layer that should line the myometrial layer. On average, the external diameter is only half the diameter of the vessels in a normal placenta, and the endothelial layer and musculoelastic tissue do not disappear in the deeper myometrial arteries. Ischemic placenta and hypertension in pregnancy are caused by trophoblast invasion disorders with high severity in the spiral arteries (Ives et al., 2020; Torres-Torres et al., 2024). Another consistent finding is from (Sutni et al., 2023) where the bivariate analysis with chi-square statistical testing showed a p-value of 0.004 ($p < 0.05$), indicating a significant relationship between multiple pregnancies and the occurrence of preeclampsia. The relationship between multiple pregnancies presents a higher risk to both the baby and the mother. The growth of multiple fetuses is more often disturbed compared to singleton fetuses, such as the occurrence of preeclampsia due to the added circulatory burden to the fetuses.

CONCLUSION

There is a relationship between BMI, multiple pregnancies, and parity with the onset of preeclampsia in pregnant women in Kotabaru District, South Kalimantan Province. The most dominant variable that is most related to the occurrence of early-onset preeclampsia at Dirgahayu Health Center in Kotabaru District is BMI while age and parity contribute and have the potential to cause preeclampsia.

ACKNOWLEDGEMENTS

The author expresses gratitude to the Master's Program in Midwifery at STIKES Guna Bangsa Yogyakarta as the beloved alma mater for providing guidance and valuable knowledge, enabling the publication of this research.

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