



Correlation of preeclampsia degree with NICU admission rate in neonates at Bhayangkara Hasta Brata Batu Hospital

Afif Rahman Maulana¹, Miftakhul Ulfa², Wira Daramatasia³

^{1,2,3}Program Studi Pendidikan Ners, Sekolah Tinggi Ilmu Kesehatan Widyagama Husada Malang, Indonesia

Article Info

Article history:

Received Aug 29, 2026

Revised Sep 4, 2026

Accepted Sep 13, 2026

Keywords:

Neonatal Intensive Care;

Neonatal Outcome;

Neonates;

NICU;

Preeclampsia Degree.

ABSTRACT

Preeclampsia is a pregnancy complication that may affect maternal and neonatal conditions. Impaired placental perfusion caused by preeclampsia increases the risk of prematurity, low birth weight, respiratory disorders, and the need for Neonatal Intensive Care Unit (NICU) admission. This study aimed to determine the correlation between preeclampsia degree and NICU admission rate in neonates at Bhayangkara Hasta Brata Batu Hospital. This retrospective observational analytic study included 32 mothers with preeclampsia and their neonates selected using total sampling. Data were collected from medical records and analyzed using Somers' d. Sixteen neonates (50%) received NICU care and 16 (50%) did not. NICU admission increased across preeclampsia severity: 0% in mild, 54.5% in moderate, and 90.9% in severe preeclampsia. Somers' d showed a significant positive correlation ($p < 0.001$; $d = 0.598$). Clinically, these findings indicate that severe preeclampsia identifies a group with a substantially higher likelihood of neonatal intensive care needs, supporting early neonatal risk assessment and readiness of NICU resources. However, the findings should be interpreted as an association rather than a validated prediction model because other determinants of NICU admission were not simultaneously modeled.

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Corresponding Author:

Afif Rahman Maulana,

Program Studi Pendidikan Ners,

Sekolah Tinggi Ilmu Kesehatan Widyagama Husada Malang,

Jl. Taman Borobudur No. 3A, Mojolangu, Lowokwaru, Malang, Jawa Timur, 65142, Indonesia

Email : apiprahman1120@gmail.com

1. INTRODUCTION

Preeclampsia is one of the pregnancy complications classified as a hypertensive disorder of pregnancy and remains an important cause of maternal and neonatal morbidity and mortality. This condition is characterized by increased blood pressure occurring after 20 weeks of gestation, which may be accompanied by proteinuria or signs of maternal organ dysfunction. The clinical manifestations of preeclampsia vary in severity, resulting in different risks of complications for both mothers and fetuses (American College of Obstetricians and Gynecologists, 2020).

The impact of preeclampsia on neonates is closely related to impaired placental function due to endothelial dysfunction and vascular disorders during pregnancy. These changes cause a decrease in uteroplacental perfusion which has an impact on the reduced supply of oxygen and nutrients for fetal growth. If this condition progresses progressively, various neonatal complications can occur such as fetal growth inhibition, low birth weight, premature birth, asphyxia, and respiratory adaptation disorders after birth (Redman & Sargent, 2010).

Complications experienced by neonates due to disorders during pregnancy often require further monitoring and intervention after birth. One form of service provided to high-risk neonates is treatment in the Neonatal Intensive Care Unit (NICU). This care unit provides intensive monitoring and medical support for neonates who experience physiological disorders or have a risk of complications, such as prematurity, low birth weight, respiratory disorders, and postnatal adaptation disorders. Thus, NICU care numbers can be used as an illustration of the impact of maternal conditions on neonatal outcomes (American Academy of Pediatrics [AAP], 2021).

From a clinical perspective, identifying maternal factors associated with NICU need may support early neonatal risk stratification and preparation of neonatal services. However, previous studies have generally demonstrated associations between preeclampsia and adverse neonatal outcomes rather than developed a simple clinical approach for estimating NICU need according to different degrees of preeclampsia. Therefore, examining the gradient of NICU need across preeclampsia severity may provide preliminary information that can be used to anticipate neonatal intensive care requirements.

Several previous studies have shown that preeclampsia is associated with an increased risk of poor neonatal outcomes. Research by Socol et al. (2024) shows that neonates born to mothers with preeclampsia have a higher risk of developing prematurity, low birth weight, and requiring NICU care compared to neonates from mothers without preeclampsia. These findings suggest that maternal pregnancy disorders can affect neonatal conditions and the need for intensive care after birth.

In addition to the presence of preeclampsia, the severity of the disease is also a factor that needs to be considered in estimating the risk of neonatal complications. Research by Tadese, (2024) shows that mothers with severe features preeclampsia have a high rate of neonatal complications, including the incidence of low birth weight, prematurity, and the need for NICU care. This suggests that the more severe the clinical manifestations of preeclampsia, the more likely the neonates are to experience conditions that require special treatment.

Although previous studies have established an association between preeclampsia and adverse neonatal outcomes, important gaps remain regarding the relationship between the severity of preeclampsia and the need and duration of NICU care. Existing evidence has more commonly focused on the presence of preeclampsia or severe preeclampsia and has not consistently compared NICU requirements across different severity categories. In addition, evidence regarding whether increasing preeclampsia severity is associated with longer NICU hospitalization remains limited. Differences in gestational age, birth weight, neonatal condition, maternal comorbidities, delivery characteristics, and the availability and criteria of neonatal intensive care services may also influence NICU admission and duration, making findings difficult to generalize across hospitals. Therefore, further hospital-specific evidence is needed to describe the pattern of NICU need according to preeclampsia severity and to determine whether severity may serve as an early indicator for neonatal care requirements.

The present study addresses these gaps by examining the distribution of NICU care across mild, moderate, and severe preeclampsia in a single hospital setting. The observed gradient in this study, in which NICU care occurred in 0% of neonates in the mild group, 54.5% in the moderate group, and 90.9% in the severe group, provides preliminary evidence that preeclampsia severity may contribute to early neonatal risk stratification. Compared with previous studies that primarily demonstrated the association between preeclampsia and adverse neonatal outcomes, this study provides a more clinically oriented description of how NICU need varies according to preeclampsia severity. However, because this study used a small retrospective sample and did not incorporate multiple neonatal and maternal predictors into a predictive model, the findings should be considered preliminary evidence for risk stratification rather than a validated prediction model for NICU admission or duration.

Based on these gaps, this study aimed to analyze the relationship between the degree of preeclampsia and the need for NICU care in neonates at Bhayangkara Hasta Brata Batu Hospital using an analytical observational design with a retrospective approach based on medical record data. The study specifically sought to describe the pattern of NICU care across mild, moderate, and severe preeclampsia and to assess whether increasing preeclampsia severity was associated with a higher level of NICU care. Although the findings may provide preliminary information for early neonatal risk stratification and preparation of neonatal services, they are not intended to constitute a validated prediction model. The results may serve as a basis for future prospective and multicenter studies incorporating additional predictors to develop and validate a clinically applicable model for predicting NICU admission and duration.

2. RESEARCH METHOD

This study uses a quantitative approach with an analytical observational design and a retrospective approach. The study aims to analyze the relationship between the degree of preeclampsia and the number of Neonatal Intensive Care Unit (NICU) care in neonates at Bhayangkara Hasta Brata Batu Hospital. The research data was obtained through tracing the medical records of maternity mothers with a diagnosis of preeclampsia along with data on the condition of the newborn after birth.

The study population consisted of mothers with a documented diagnosis of preeclampsia and their live-born neonates delivered at Bhayangkara Hasta Brata Batu Hospital during the study period. Total sampling was applied, meaning that all eligible mother-neonate pairs meeting the predefined inclusion criteria during the study period were included in the study. The inclusion criteria were: (1) mothers who delivered with a diagnosis of preeclampsia documented in the medical record; (2) live-born neonates delivered at Bhayangkara Hasta Brata Batu Hospital; and (3) complete and accessible maternal and neonatal medical-record data, including documentation of preeclampsia severity and neonatal care status. The exclusion criteria were: (1) medical records with missing or insufficient information required for classification of preeclampsia severity or NICU care status; and (2) mothers with another major comorbidity documented in the medical record that was considered to dominate the neonatal outcome and prevented assessment of the relationship between preeclampsia severity and NICU care. Application of these criteria resulted in 32 eligible mother-neonate pairs.

The degree of preeclampsia was operationally categorized according to the diagnosis and clinical data documented in the medical record. Mild preeclampsia was operationally defined as blood pressure $\geq 140/90$ mmHg without documented maternal organ dysfunction; moderate preeclampsia was defined as blood pressure $\geq 140/90$ mmHg accompanied by proteinuria but without documented severe maternal organ dysfunction; and severe preeclampsia was defined as blood pressure $\geq 160/110$ mmHg and/or documented maternal organ dysfunction or fetal growth restriction. The classification was based on the clinical diagnosis and supporting findings recorded in the medical record.

NICU care was operationally defined based on the neonatal care status and duration of NICU treatment documented in the medical record. "Not admitted" was defined as a neonate who had no documented admission or treatment in the NICU after birth. "NICU care <48 hours" was defined as a neonate who was documented as admitted to and treated in the NICU for a total duration of less than 48 hours. "NICU care >48 hours" was defined as a neonate who was documented as admitted to and treated in the NICU for more than 48 hours. The duration was determined from the documented time of NICU admission until the documented time of transfer or discharge from the NICU. Thus, NICU admission status was distinguished from duration of NICU care, with the latter categorized into <48 hours and >48 hours.

Data collection was performed using an observation sheet based on information extracted from the maternal and neonatal medical records. Data analyzed included maternal characteristics, degree of preeclampsia, gestational age, neonatal birth weight, Apgar score, and NICU care status.

Data were analyzed using univariate and bivariate analysis. Univariate analysis described the distribution of maternal and neonatal characteristics. Bivariate analysis assessed the relationship between preeclampsia degree and NICU care using Somers' d because both variables were ordinal, with statistical significance set at $p < 0.05$. Birth weight and Apgar score were described as neonatal characteristics and were not included as covariates in the primary Somers' d analysis. (Chen et al., 2019).

3. RESULTS AND DISCUSSIONS

Respondent Characteristics

This study involved 32 mothers with a diagnosis of preeclampsia along with neonates born at Bhayangkara Hasta Brata Batu Hospital. The characteristics of the respondents analyzed included maternal age, gestational age, parity, degree of preeclampsia, infant birth weight, Apgar Score, and NICU care status. The distribution of respondent characteristics is presented in Table 1.

Characteristics	Category	f	%
Maternal age	24-35 years	21	65.6
	>35 years	11	34.4
Gestational age	33-35 weeks	10	31.3
	36-37 weeks	12	37.6
	38-40 weeks	10	31.3
	1	11	34.4
Parity	2	11	34.4
	3	8	25.0
	4	2	6.3
	Mild	10	31.3
Preeclampsia degree	Moderate	11	34.4
	Severe	11	34.4

Based on Table 1, most of the mothers in the study were in the age group of 24-35 years as many as 21 respondents (65.6%), while mothers with the age of >35 years were 11 respondents (34.4%). Based on gestational age, the largest group was at 36-37 weeks gestational age as many as 12 respondents (37.6%). This shows that most deliveries occur at the gestational age close to full term, although there are still cases of premature delivery in the gestational age group of 33-35 weeks.

Parity characteristics showed that most mothers had parity of 1 and 2 with 11 respondents each (34.4%). Based on the degree of preeclampsia, the most cases were found in the moderate and severe preeclampsia groups with 11 respondents each (34.4%), while mild preeclampsia was 10 respondents (31.3%). The distribution showed that most of the respondents experienced preeclampsia conditions with a severity that has the potential to increase the risk of neonatal complications.

The characteristics of neonates showed that most of the babies had a birth weight of ≥ 2500 grams, 23 neonates (71.9%), while babies with low birth weight (< 2500 grams) were 9 neonates (28.1%). Based on the Apgar Score value, most of the neonates were in the 7-9 category as many as 18

neonates (56.1%). However, there were neonates with early conditions that required more intensive monitoring after birth.

When examined according to the degree of preeclampsia, low birth weight was not distributed equally across the severity groups. In the mild preeclampsia group, none of the 10 neonates (0%) had a birth weight below 2500 grams. In the moderate preeclampsia group, 2 of 11 neonates (18.2%) had a low birth weight, whereas all 11 neonates (100%) in the severe preeclampsia group had a birth weight below 2500 grams. This descriptive pattern indicates that low birth weight was more frequently observed with increasing preeclampsia severity. The pattern also coincided with an increasing proportion of NICU care, namely 0% in the mild group, 54.5% in the moderate group, and 90.9% in the severe group. However, these findings should be interpreted descriptively because low birth weight was not separately tested as an independent predictor of NICU admission in this study.

A similar descriptive pattern was observed for the Apgar Score. Neonates in the mild preeclampsia group had Apgar Scores of 8–9 and did not require NICU care. In the moderate preeclampsia group, Apgar Scores ranged from 6 to 8, with 3 of 11 neonates (27.3%) having a score of 6, while 6 neonates (54.5%) received NICU care. In the severe preeclampsia group, Apgar Scores ranged from 4 to 6, and 10 of 11 neonates (90.9%) received NICU care. Thus, lower Apgar Scores were more frequently observed among neonates born to mothers with more severe preeclampsia and were commonly accompanied by NICU care. Nevertheless, Apgar Score should not be considered the sole determinant of NICU admission because the decision for neonatal intensive care may also depend on the neonate's respiratory status, gestational age, birth weight, clinical adaptation, and other neonatal conditions. The present study describes this pattern but does not provide a separate statistical test of the relationship between Apgar Score and NICU admission.

The Relationship of Preeclampsia Degree with NICU Care in Neonates

The analysis of the relationship between the degree of preeclampsia and NICU treatment in neonates was carried out using the Somers' d test. The selection of this test was adjusted to the characteristics of the research data using ordinal scales on both variables. The results of the relationship analysis are presented in Table 2.

Table 2. Relationship of preeclampsia degree with NICU care in neonates

Definite preeclampsia	No NICU f (%)	NICU <48 for hours f (%)	NICU >48 to hours f (%)	Total	Somers'd	P value
Lightweight	10 (100)	0 (0)	0 (0)	10	0,598	0,000
Medium	5 (45,5)	6 (54,5)	0 (0)	11		
Weight	1 (9,1)	10 (90,9)	0 (0)	11		
Total	16 (50)	16 (50)	0 (0)	32		

Based on Table 2, there is a tendency to increase the need for NICU care along with the increasing degree of preeclampsia. In the group of mothers with mild preeclampsia, all neonates did not need NICU treatment. In the moderate preeclampsia group, as many as 6 neonates (54.5%) received NICU treatment, while in the severe preeclampsia group, as many as 10 neonates (90.9%) needed NICU treatment.

The results of the Somers' d test showed a p-value of <0.001 with a coefficient value of 0.598. These results showed that there was a significant relationship between the degree of preeclampsia and the number of NICU care in neonates. The positive coefficient value indicated that the more severe the degree of preeclampsia, the more likely it was that the neonates would need NICU care.

The relationship between the degree of preeclampsia and the need for NICU care can be explained through the mechanism of placental dysfunction. In preeclampsia, vascular disorders and endothelial dysfunction occur which cause a decrease in uteroplacental perfusion. These conditions result in reduced oxygen and nutrient supply to the fetus, increasing the risk of neonatal complications such as prematurity, low birth weight, respiratory disorders, and impaired adaptation after birth.

The results of this study are in line with previous studies that showed that preeclampsia is associated with an increased risk of poor neonatal outcomes. Neonates born to mothers with preeclampsia have a higher risk of complications that require intensive neonatal care compared to neonates from mothers without preeclampsia. In addition, the severity of preeclampsia also affects the increased risk of prematurity, low birth weight, and the need for NICU care.

From a clinical perspective, the observed gradient in NICU care across preeclampsia severity has implications for early neonatal risk stratification and preparation of neonatal services. In this study, NICU care was required in 0% of neonates in the mild preeclampsia group, 54.5% in the moderate group, and 90.9% in the severe group. Therefore, identification of severe preeclampsia before delivery may alert the obstetric and neonatal teams to the greater possibility of neonatal stabilization and intensive monitoring after birth. This information may support earlier communication between obstetric and neonatal teams and assist in preparing appropriate NICU personnel, equipment, monitoring capacity, and referral arrangements when necessary. However, preeclampsia severity should be regarded as an early risk indicator rather than an automatic criterion for NICU admission, because the final decision should remain based on the neonate's clinical condition and established NICU admission criteria.

Despite the significant association observed in this study, the findings should not be interpreted as demonstrating a causal relationship between preeclampsia severity and NICU admission. This study used a retrospective observational design, and no experimental manipulation or randomization was performed. In addition, several factors that may influence NICU admission, including gestational age, birth weight, Apgar Score, respiratory condition, mode of delivery, maternal or fetal complications, and clinical decision-making, were not simultaneously controlled in the primary analysis. The sample was also relatively small and obtained from a single hospital, which may limit the generalizability of the findings. Therefore, the Somers' d coefficient of 0.598 should be interpreted as evidence of a significant positive association within this study population rather than as an estimate of the causal effect of preeclampsia severity on NICU admission.

4. CONCLUSION

This study shows that there is a significant relationship between the degree of preeclampsia and the need for NICU care in neonates at Bhayangkara Hasta Brata Batu Hospital. The results show that the higher the severity of preeclampsia, the greater the tendency for neonates to require NICU care. This relationship was demonstrated by the Somers' d test with a p-value <0.001 and a correlation coefficient of 0.598, indicating a positive and moderate relationship between preeclampsia severity and the need for NICU care.

These findings contribute to decision-making regarding NICU readiness by indicating that the degree of preeclampsia can be used as an early risk-stratification factor before delivery. In this study, NICU care was required in 0% of neonates in the mild preeclampsia group, 54.5% in the moderate group, and 90.9% in the severe group. These findings may therefore support delivery-planning decisions by prompting earlier coordination between obstetric and neonatal teams and ensuring that appropriate NICU personnel, equipment, monitoring capacity, and referral arrangements are prepared when delivery is anticipated in cases of moderate or severe preeclampsia. However, preeclampsia severity should be used to support readiness and anticipatory planning rather than as a stand-alone criterion for NICU admission, because the final decision should remain based on the neonate's clinical condition and established neonatal care criteria.

The differences in observed NICU risk between mild, moderate, and severe preeclampsia have important implications for childbirth care. The absence of NICU admission in the mild preeclampsia group, compared with NICU care in 54.5% of the moderate group and 90.9% of the severe group, suggests that the level of neonatal preparedness should be adjusted according to preeclampsia severity. In particular, deliveries involving moderate and severe preeclampsia may require greater preparedness for neonatal stabilization, closer monitoring immediately after birth,

and more intensive coordination between obstetric and neonatal teams. Nevertheless, these observed differences should be used to guide preparedness rather than to determine NICU admission automatically, because individual neonatal clinical conditions remain important in the admission decision.

Further research should focus on developing and validating a multivariable predictive model for NICU need using prospective, multicenter data with a larger sample size. Future prediction models should combine preeclampsia severity with clinically relevant maternal and neonatal predictors, including gestational age, birth weight, Apgar Score, maternal and fetal complications, mode of delivery, and the neonate's immediate clinical condition. The development process should include appropriate model specification, internal validation, and external validation in an independent population, followed by assessment of model discrimination and calibration before consideration of clinical implementation. Such research would allow preeclampsia severity to be evaluated as one component of a broader and clinically applicable prediction model rather than as a stand-alone predictor of NICU admission.

ACKNOWLEDGEMENTS

The author would like to express his gratitude to Bhayangkara Hasta Brata Batu Hospital for providing permission and support in the process of collecting research data. The author also expressed his gratitude to the Nurse Education Study Program of the Widyagama Husada College of Health Sciences Malang and the supervisors who have provided direction and support during the process of preparing this research. Appreciation is also expressed to all parties who have helped so that this research can be carried out properly.

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