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FACTORS ASSOCIATED WITH NEONATAL OUTCOMES IN PREMATURE RUPTURE OF MEMBRANES

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ABSTRAK

Ketuban pecah dini (KPD) meningkatkan risiko infeksi maternal dan morbiditas neonatal. Penelitian cross-sectional di RS Pertamedika Ummi Rosnati (Juli–Oktober 2025) melibatkan 31 ibu hamil dengan KPD. Data meliputi umur ibu, kadar leukosit, berat lahir, usia kehamilan, serta luaran bayi (NICU vs rooming-in). Rerata umur ibu 29,5 tahun, berat lahir 2682 g, leukosit 13,3 ribu/µL. Berat lahir bayi berbeda signifikan antara kelompok NICU (2300 g) dan rooming-in (2839 g) (p=0,001). Usia kehamilan preterm berhubungan dengan perawatan NICU (p=0,003), dengan 66,7% bayi preterm memerlukan NICU. Berat lahir berkorelasi kuat dengan skor Apgar (r=0,599; p<0,001), sedangkan umur ibu dan leukosit tidak signifikan. Analisis menunjukkan berat lahir dan usia kehamilan sebagai faktor utama luaran neonatal pada KPD. Pemantauan ketat dan manajemen klinis diperlukan untuk meningkatkan hasil.

ABSTRACT

Premature rupture of membranes (PROM) increases the risk of maternal infection and neonatal morbidity. A cross-sectional study at Pertamedika Ummi Rosnati Hospital (July–October 2025) involved 31 pregnant women with PROM. Data included maternal age, leukocyte count, birth weight, gestational age, and infant outcomes (NICU vs. rooming-in). The mean maternal age was 29.5 years, birth weight 2682 g, and leukocyte count 13.3 thousand/µL. Infant birth weight differed significantly between the NICU (2300 g) and rooming-in (2839 g) groups (p=0.001). Preterm gestational age was associated with NICU admission (p=0.003), with 66.7% of preterm infants requiring NICU admission. Birth weight was strongly correlated with Apgar score (r=0.599; p<0.001), while maternal age and leukocyte count were not significant. Analysis indicates that birth weight and gestational age are the main factors in neonatal outcomes in PROM. Close monitoring and clinical management are needed to improve outcomes.

INTRODUCTION

Premature Rupture of Membranes (PROM), or in Indonesian known as Ketuban Pecah Dini (KPD), is a condition in which the amniotic and chorionic membranes rupture before the onset of uterine contractions that mark labor. PROM is defined as the rupture of membranes before the onset of labor, meaning before regular and progressive uterine contractions occur accompanied by cervical changes. If this condition occurs at ≥37 weeks of gestation, it is referred to as PROM, whereas if it occurs before 37 weeks of gestation, it is called Preterm Premature Rupture of Membranes (PPROM). This condition requires careful management as it can pose serious risks to both the mother and fetus, including intrauterine infection, preterm delivery, and impaired fetal growth and development.[1]

Globally, the prevalence of premature rupture of membranes varies between 5% to 15% of all pregnancies. PPROM itself accounts for approximately 30% to 40% of all preterm births, making it one of the leading causes of prematurity. Studies in various countries show varying prevalence rates, such as 13.7% in Ethiopia, 7.5% in Uganda, and 5.3% in Egypt. In the United States, the incidence of PPROM is reported at approximately 1.4%.[2] National data from the Basic Health Research (Riskesdas) in 2023 indicates that premature rupture of membranes is among the top 10 causes of obstetric referrals from primary healthcare facilities to hospitals.[3] Meanwhile, in Aceh, the 2022 report from the Aceh Provincial Health Office shows that premature rupture of membranes accounts for approximately 7.8% of total obstetric referral cases, with higher incidence among young pregnant women and mothers with poor nutritional status..[4]

Rupture of membranes during labor is generally caused by uterine contractions and repetitive stretching. The membranes rupture because certain areas undergo biochemical changes that cause the inferior membranes to become fragile. Risk factors for premature rupture of membranes include reduced ascorbic acid as a collagen component, as well as deficiency of copper and ascorbic acid resulting in abnormal structural growth, among others due to smoking. The membranes are very strong during early pregnancy, but in the third trimester, they rupture easily. The weakening of membrane strength is associated with uterine enlargement, uterine contractions, and fetal movements.[5]

Pathophysiologically, rupture of membranes is the end result of a process involving extracellular matrix degradation, membrane cell apoptosis, and disruption of the balance between collagen synthesis and breakdown. Inflammatory processes, whether due to infection or non-infectious stimuli, trigger the release of proinflammatory cytokines such as interleukin-6 and TNF-α, which increase matrix metalloproteinase (MMP) activity, thereby compromising the mechanical integrity of the amniotic and chorionic membranes. When intrauterine pressure increases or membrane resistance is compromised, the membranes can rupture prematurely.[1]

Diagnosis of premature rupture of membranes is crucial to be established accurately and promptly as it is closely associated with the risk of maternal-neonatal infection and preterm birth. The diagnostic process relies on clinical approaches and supportive examinations. History taking is the initial step in establishing the diagnosis, with typical complaints of sudden discharge of fluid from the vagina that cannot be controlled, usually colorless and odorless. Patients may describe a sensation of "seeping" or "gushing" of fluid from the birth canal, which may occur continuously or intermittently.[6]

Physical examination is performed using a sterile vaginal speculum to directly visualize clear fluid coming out of the external cervical os. This examination is important to be conducted visually and must be performed before digital vaginal examination to prevent the risk of infection. Supportive examinations include the litmus test, ferning test, ultrasonography to assess the amniotic fluid index, as well as immunoassay testing for specific proteins such as IGFBP-1 (Insulin-like Growth Factor Binding Protein-1) or PAMG-1 (Placental Alpha Microglobulin-1).[6]

Complications of premature rupture of membranes are quite extensive, affecting both the mother and fetus. In the mother, the risks of intrauterine infection (chorioamnionitis), postpartum endometritis, placental abruption, and preterm labor are increased. In the fetus, common complications include prematurity, neonatal sepsis, pulmonary hypoplasia (especially if premature rupture of membranes occurs at <24 weeks), as well as umbilical cord complications such as prolapse or compression. Poor neonatal outcomes are often characterized by low Apgar scores, low birth weight, and the need for care in the Neonatal Intensive Care Unit (NICU).[5]

Management of premature rupture of membranes is highly dependent on gestational age, signs of infection, fetal condition, and cervical readiness. In term pregnancies, induction of labor within 12-24 hours after membrane rupture is generally recommended to prevent infection. In preterm pregnancies, a conservative approach with hospitalization, administration of antibiotics, corticosteroids for fetal lung maturation, and magnesium sulfate (if gestational age is <32 weeks) can prolong the pregnancy and reduce neonatal morbidity. The decision for pregnancy termination must be considered individually based on maternal and fetal conditions.[7]

Laboratory examinations including maternal leukocyte levels are one of the parameters that can help in assessing the presence of infection or systemic inflammatory response. However, the relationship between various maternal factors such as leukocyte levels, maternal age, birth weight, and gestational age with neonatal outcomes in premature rupture of membranes cases still requires further investigation, particularly in the local Indonesian setting.

This study was conducted to analyze factors associated with neonatal outcomes in premature rupture of membranes cases at Pertamedika Ummi Rosnati Hospital. By understanding these factors, it is expected to provide useful information in clinical management and prediction of neonatal outcomes, so that more appropriate interventions can be implemented to reduce neonatal morbidity and mortality.

This study aims to analyze the characteristics of pregnant women with premature rupture of membranes and to assess the relationship between maternal age, birth weight, maternal leukocyte levels, and gestational age with neonatal outcomes. Furthermore, this study also aims to identify the most influential predictive factors for neonatal outcomes in premature rupture of membranes cases, in order to provide a more comprehensive picture of the factors that play a role in determining the final condition of the infant.

METHODS

Study Design and Location

This study is a quantitative research with an analytical observational design using a cross-sectional approach. The study was conducted at Pertamedika Ummi Rosnati Hospital, Banda Aceh, during the period of July to October 2025.

Population and Sample

The study population consisted of all pregnant women with premature rupture of membranes who were admitted to the obstetrics ward of Pertamedika Ummi Rosnati Hospital from July 1 to October 30, 2025. This study involved 31 respondents who gave birth (86.1% of the total 36 cases) with complete data for analysis. The sampling technique used was total sampling.

Inclusion criteria included: (1) Pregnant women with a clinically confirmed diagnosis of premature rupture of membranes; (2) Having complete medical records; (3) Giving birth at Pertamedika Ummi Rosnati Hospital. Exclusion criteria included: (1) Mothers with multiple pregnancies; (2) Mothers with severe chronic diseases; (3) Incomplete medical record data.

Study Variables

Independent variables included maternal leukocyte levels (10^3/μL), maternal age (years), birth weight (grams), and gestational age (preterm <37 weeks vs term ≥37 weeks). The dependent variable was neonatal outcome categorized into two groups: (1) NICU, which is an intensive care unit specifically for newborns, and (2) Rooming-in, which refers to healthy infants who can be cared for together with their mothers. Additional variables observed were Apgar scores at the first minute and fifth minute.

Data Collection

Data were collected through patient medical record review using a prepared data collection form. The data collected included patient identity, maternal characteristics (maternal age, laboratory examination results including leukocyte levels), neonatal characteristics (birth weight, gestational age, Apgar score, and the infant's place of care after birth).

Data Analysis

The collected data were processed through the stages of editing, coding, data entry, cleaning, and tabulation. Data analysis was performed using SPSS version 25. Descriptive analysis was used to describe the sample characteristics. Data normality tests were conducted using Kolmogorov-Smirnov and Shapiro-Wilk tests. Bivariate analysis used independent t-test for numerical variables and chi-square test for categorical variables. For the maternal age variable which showed non-normal distribution based on the Shapiro-Wilk test ($p=0.020$), Mann-Whitney U test was performed as a sensitivity analysis to ensure the robustness of the results. Correlation analysis used Pearson's test. Multivariate analysis used exploratory binary logistic regression considering the sample size limitations. The significance level used was $\alpha = 0.05$.

Research Ethics

Patient data were kept confidential and were only used for research purposes.

RESULTS

Subject Characteristics

This study involved 31 pregnant women with premature rupture of membranes who gave birth at Pertamedika Ummi Rosnati Hospital during the period of July-October 2025. The subject characteristics are presented in Table 1.

Table 1. Subject Characteristics

Variable	N	Percentage / Mean±SD
Materal age (years)	31	29,48±5,66 (22-42)
Birth weight (gr)	31	2682,26±440,94(1800-3500)
Mat-Leu	31	13,30±3,13(8-18) (10^3/ μL)
Gestational Age:		
Preterm(<37 wk)	9	29,0%
Term (≥37 wk)	22	71,0%
Neonatal Outcome:		
- NICU	9	29,0%
- Rooming-in	22	71,0%

Mat-Leu : Maternal Leukocytes

Based on table 1, the mean maternal age was 29.48±5.66 years with a range of 22-42 years. The mean birth weight was 2682.26±440.94 grams with a range of 1800-3500 grams. The mean maternal leukocyte level was 13.30±3.13 thousand/µL with a range of 8-18 thousand/µL. The majority of pregnancies were term (71.0%) and most infants were able to undergo rooming-in (71.0%). Regarding the mode of delivery, most patients underwent cesarean section (26 patients, 83.9%) compared to normal delivery (5 patients, 16.1%). All patients (100%) received prophylactic antibiotics and antenatal corticosteroids according to the hospital protocol.

Data Normality Test

Normality tests were performed using Kolmogorov-Smirnov and Shapiro-Wilk tests to determine the type of statistical test to be used. The analysis results are presented in Table 2.

Table 2. Data Normality Test Result

Variable	Kolmogorov-Smirnov (Sig.)	Shapiro-Wilk (Sig.)	Distribution
Maternal Age	0,200	0,020	Not Normally Distributed*
Birth Weight	0,200	0,553	Normally Distributed
Maternal Leukocytes	0,200	0,255	Normally Distributed

**Based on uji Shapiro-Wilk*

The Shapiro-Wilk test results for maternal age showed a p-value of 0.020 (p<0.05), indicating a non-normal distribution. Nevertheless, the independent t-test was still used for the maternal age analysis with the considerations that: (1) The t-test is known to be fairly robust against violations of normality assumptions, especially when the sample size approaches or exceeds 30; (2) The Central Limit Theorem states that the sampling distribution of the mean approaches normal distribution with a sufficiently large sample; and (3) The maternal age distribution showed a skewness of 0.827 which is still within tolerable limits (<2). As a sensitivity analysis, the Mann-Whitney U test was also performed to validate the t-test results for the maternal age variable.

Bivariate Analysis

Differences in Maternal and Neonatal Characteristics Based on Neonatal Outcome. Analysis of differences in characteristics between the NICU and Rooming-in groups was performed using the independent t-test for numerical variables. Levene's Test showed that homogeneity of variance was met for all variables (p>0.05). The analysis results are presented in Table 3.

Table 3. Differences in Characteristic Based on Neonatal Outcomes

Variable	Outcomes	N	Mean ±SD	t	p-value	Mean Difference
Maternal Age	NICU	9	31,22±5,52	1,097	0,282	2,45
	Rooming-in	22	28,77±5,69			
Birth Weight	NICU	9	2300±364	-3,675	0,001**	-538,64

Variable	Outcomes	N	Mean ±SD	t	p-value	Mean Difference
	Rooming-in	22	2839± 372			
Maternal Leukocytes	NICU	9	13,56± 3,81	0,287	0,777	0,36
	Rooming-in	22	13,20± 2,90			

$^{**}p<0,01$ (significant)

The independent t-test results showed:

- Maternal age: There was no significant difference between the NICU and Rooming-in groups (t=1.097; p=0.282). The mean maternal age in both groups was relatively comparable.
- Birth weight: There was a highly significant difference between the NICU and Rooming-in groups (t=-3.675; p=0.001). The NICU group had a significantly lower mean birth weight compared to the Rooming-in group with a mean difference of -538.64 grams (95% CI: -838.42 to -238.85).
- Maternal leukocytes: There was no significant difference between the NICU and Rooming-in groups (t=0.287; p=0.777). Maternal leukocyte levels were relatively comparable in both groups.

Mann-Whitney U test sensitivity analysis for the maternal age variable.

Considering the non-normal distribution of the maternal age variable based on the Shapiro-Wilk test, a sensitivity analysis was performed using the Mann-Whitney U test as a non-parametric alternative. The analysis results are presented in Table 3a.

Table 3a. Sensitivity Analysis; Comparison

Test Statistic	Value Statistik	p-value
Independent T-Test	t = 1,097	0,282
Mann-Whitney U Test	U = 129,5	0,190

The Mann-Whitney U test results (U=129.5; p=0.190) showed conclusions consistent with the independent t-test (t=1.097; p=0.282), namely that there was no significant difference in maternal age between the NICU and Rooming-in groups. The consistency of results from both tests strengthens the validity of the finding that maternal age is not a factor that differentiates neonatal outcomes in this study.

Relationship Between Gestational Age and Neonatal Outcome

Analysis of the relationship between gestational age (preterm vs term) and neonatal outcome was performed using the chi-square test. The analysis results are presented in Table 4.

Table 4. The Association Between Gestasional Age and Neonatal Outcomes

Gestasional Age	NICU (%)	Rooming-in (%	Total (%)
Preterm (<37 wk)	6 (66,7%)	3 (33,3%)	9 (100%)
Aterm (≥37 wk)	3 (13,6%)	19 (86,4%)	22 (100%)
Total	9 (29,0%)	22 (71,0%)	31 (100%)

*χ^2=8,718; p=0,003**

The chi-square test results showed a significant relationship between gestational age and neonatal outcome ($\chi^2=8.718$; p=0.003). Fisher's Exact Test provided consistent results (p=0.007). Preterm infants had a 66.7% risk of NICU admission, much higher compared to term infants who only had a 13.6% NICU admission rate. This indicates that gestational age is an important factor affecting neonatal outcomes.

Correlation Analysis

Pearson correlation analysis was performed to assess the relationship between continuous variables and infant Apgar scores. The analysis results are presented in Table 5.

Table 5. Correlation 0f Variables with Apgar Score

Variable	r (Pearson)	Sig. (2-tailed)
Birth Weight 1-Minute AS	0,599	<0,001**
Birth Weight 5-Minute AS	0,599	<0,001**
Mat-Leu 1-Minute AS	0,012	0,951
Mat-Leu 5-Minute AS	0,012	0,951

*AS : Apgar Score, Mat-Leu : Maternal Leukocytes, **Significant at α=0,01*

The analysis results showed a strong and highly significant positive correlation between birth weight and Apgar score at the 1st minute (r=0.599; p<0.001) and Apgar score at the 5th minute (r=0.599; p<0.001). This indicates that the higher the birth weight, the higher the Apgar score obtained, suggesting a better infant condition at birth. Conversely, there was no significant correlation between maternal leukocyte levels and Apgar score at the first minute (r=0.012; p=0.951) or apgar score at the fifth minute (r=0.012; p=0.951).

Multivariate Analysis

Multivariate analysis using binary logistic regression was performed to identify predictors of neonatal outcome (NICU vs Rooming-in) by simultaneously including the variables of maternal age, gestational age, birth weight, and maternal leukocytes. It should be noted that with a sample size of n=31 and 4 independent variables, the events per variable (EPV) ratio is approximately 2.25 (9 events/4 variables), which is below the recommended minimum of 10 EPV for logistic regression. Therefore, the results of this analysis are exploratory and should be interpreted with caution. The analysis results are presented in Table 6.

Table 6. Results of Multivariate Logistic Regression Analysis

Variable	B (Koefisien)	Sig.	Exp(B) OR	95% CI
Materal age	-0,060	0,496	0,942	0,831-1,068
Gestational Age	0,097	0,949	1,102	0,055-22,162
Birth weight	0,004	0,092	1,004	0,999-1,008
Maternal Leukocytes	-0,131	0,478	0,877	0,611-1,259

Nagelkerke $R^2=0,463$; Accuracy=87,1%

The analysis results showed that no variable was a statistically significant individual predictor in the multivariate model (all p>0.05). Nevertheless, birth weight showed a trend approaching significance (β=0.004; Wald=2.845; p=0.092; OR=1.004; 95% CI: 0.999-1.008), indicating that each 1-gram increase in birth weight increased the likelihood of rooming-in by 0.4%. Other variables including maternal age (p=0.496), gestational age (p=0.949), and maternal leukocytes (p=0.478) did not show significant effects in the multivariate model.

The exploratory multivariate analysis results showed that no variable was a statistically significant individual predictor in the model (all p>0.05). This is most likely due to sample size limitations resulting in inadequate statistical power to detect significant effects, as well as collinearity between birth weight and gestational age.

DISCUSSION

Subject Characteristics

This study involved 31 pregnant women with premature rupture of membranes with a mean age of 29.48±5.66 years. This result is consistent with the study by Sulistyowati (2020) which found the mean age of mothers with PROM was 28.3±6.2 years.[7] Maternal age is one of the risk factors associated with pregnancy complications. Mothers with extreme ages (too young <20 years or too old >35 years) have a higher risk of experiencing pregnancy complications including premature rupture of membranes.[8] In this study, the mean maternal age was within the optimal reproductive age range (29.48 years), which may explain why age was not a factor that differentiated neonatal outcomes.

The mean maternal leukocyte level in this study was 13.30±3.13 thousand/µL, which is still within the normal physiological limits of pregnancy. Leukocyte levels in pregnant women tend to increase as a physiological response to pregnancy, with a normal range of 6,000-17,000/µL.[9] Maternal leukocytosis is a common finding in normal pregnancy and labor as a physiological response to labor stress.

Of the 31 study subjects, 29% of infants required NICU care and 71% were able to undergo rooming-in. This proportion is lower compared to the study by Rahmawati (2019) which found that 42% of infants from mothers with PROM required NICU care.[10] This difference may be due to population characteristics, quality of antenatal care, and different clinical management.

Relationship Between Birth Weight and Neonatal Outcome

This study found that birth weight was the factor most associated with neonatal outcome. Infants in the NICU group had a significantly lower mean birth weight (2300±364 grams) compared to the Rooming-in group (2839±372 grams) with p=0.001. The mean difference in birth weight of 538.64 grams between the two groups indicates that each decrease in birth weight substantially increases the risk of neonatal complications.

This finding is consistent with literature stating that low birth weight is a primary predictor of neonatal mortality and morbidity.[11] Infants with low birth weight have a higher risk of experiencing hypothermia, hypoglycemia, respiratory distress syndrome (RDS), and neonatal sepsis, thus requiring intensive care in the NICU. Infants with low birth weight often experience difficulties in extrauterine adaptation, including respiratory problems, thermoregulation, and glucose metabolism, which require medical intervention in the NICU. The study by Wijaya et al. (2020) also found that infants with birth weight <2500 grams had an odds ratio 6.8 times higher for requiring NICU care.[12]

Relationship Between Gestational Age and Neonatal Outcome

The analysis results showed a significant relationship between gestational age and neonatal outcome (p=0.003). Preterm infants had a 66.7% probability of requiring NICU care, compared to only 13.6% in term infants. Preterm birth is associated with immaturity of vital organs, especially the lungs and central nervous system, which increases the need for intensive care.

This finding is consistent with the pathophysiology of prematurity. Preterm infants have immature organs, especially the lungs, thus are at high risk of developing RDS. Additionally, preterm infants also have a higher risk of hypothermia, hypoglycemia, jaundice, and neonatal sepsis.[13] These results are consistent with previous studies showing that prematurity is a major risk factor for neonatal complications, including respiratory distress syndrome, intraventricular hemorrhage, and necrotizing enterocolitis. The study by Santosa (2021) found that 78% of preterm infants from mothers with PROM required NICU care, with longer duration of care compared to term infants.[14]

Correlation Between Birth Weight and Apgar Score

Pearson correlation showed a strong positive relationship between birth weight and Apgar score (r=0.599; p<0.001). The Apgar score is an important indicator for assessing the infant's condition immediately after birth and predicting short-term prognosis. This strong correlation indicates that infants with higher birth weight tend to have better adaptation to extrauterine life, which is reflected in higher Apgar scores. The consistency of correlation at the 1st and 5th minutes indicates that birth weight not only affects the infant's initial condition but also the infant's ability to maintain physiological stability.

Absence of Relationship Between Maternal Age and Neonatal Outcome

This study found that maternal age did not show a significant difference between the NICU and Rooming-in groups (p=0.282). In this study, the mean maternal age was within the optimal reproductive age range (29.48 years), which may explain why age was not a factor that differentiated neonatal outcomes. Literature shows that the risk of maternal and neonatal complications increases at extreme ages (<18 years or >35 years), however, the sample in this study was largely within the non-high-risk age range.[15] This finding should be interpreted with caution because the age differences were relatively small and other confounding factors such as parity, nutritional status, and antenatal care history need to be considered.

Absence of Relationship Between Maternal Leukocyte Levels and Neonatal Outcome

Interestingly, maternal leukocyte levels did not show a significant relationship with neonatal outcome, either in the independent t-test (p=0.777) or correlation with Apgar score (p=0.951). Maternal leukocytosis is a common finding in normal pregnancy and labor as a physiological response to labor stress. These results indicate that elevated leukocytes within the physiological range do not directly affect neonatal outcomes.

This finding differs from the study by Kurniawan et al. (2021) which found a strong correlation between maternal leukocytosis (>15,000/µL) and the risk of neonatal sepsis and need for NICU care.[16] This difference can be explained by several factors: (1) In this study, the mean leukocyte levels in both groups were still within normal limits; (2) The varying duration of PROM can affect the inflammatory response; (3) Prophylactic antibiotic administration can modulate the maternal leukocyte response. It should be noted that very high leukocyte levels indicating maternal infection may yield different results, which was not explored in this study.

Maternal leukocyte levels are more related to the risk of medium to long-term infection, rather than the infant's initial adaptation condition. The Apgar score is an assessment of the infant's condition immediately after birth that reflects cardiopulmonary adaptation, not maternal inflammatory response. Factors that have more influence on Apgar scores are gestational age, birth weight, mode of delivery, and intrapartum complications such as asphyxia.[17]

Multivariate Analysis

Multivariate analysis using logistic regression showed that when all variables were analyzed simultaneously, no single variable was a significant independent predictor. However, birth weight showed a trend approaching significance (p=0.092) with an odds ratio of 1.004, indicating that each 1-gram increase in birth weight increased the probability of Rooming-in by 0.4%. The multivariate model had good predictive value with Nagelkerke R^2=0.463 and overall accuracy of 87.1%, showing that the combination of these variables was able to explain most of the variability in neonatal outcomes.

The logistic regression analysis in this study is exploratory and should be interpreted with great caution. With a sample size of n=31 and 9 events (infants admitted to NICU), the events per variable (EPV) ratio was only 2.25, far below the recommended minimum of 10 EPV.[18] This limitation causes: (1) unstable coefficient estimates; (2) very wide confidence intervals; and (3) possible model overfitting. Therefore, the non-significance of variables in the multivariate model cannot be interpreted as evidence that these factors are not important, but rather reflects the limitation of statistical power due to the small sample size. Although multivariate analysis did not yield individually significant predictors, bivariate analysis showed clear and consistent results. Birth weight (p=0.001) and gestational age (p=0.003) showed significant relationships with neonatal outcomes. These bivariate findings are supported by biological plausibility and are consistent with existing literature, thus still having meaningful clinical value.

Clinical Implications

The findings of this study have important clinical implications. First, close monitoring of birth weight and gestational age is crucial in predicting neonatal outcomes in PROM cases. Early identification of pregnant women with high risk (preterm, low fetal weight) is essential for NICU facility preparation and parental counseling.

Second, close monitoring of pregnancies at risk of preterm birth can help with better preparation for optimal neonatal management. Strategies to increase birth weight through adequate maternal nutrition and management of modifiable risk factors should be a priority in antenatal care.

Third, although maternal leukocyte levels did not show a significant relationship with neonatal outcomes in this study, this parameter remains important as part of a comprehensive examination for maternal infection detection. Optimal management of PROM with prophylactic antibiotic administration, corticosteroids for lung maturation in preterm pregnancies, and close monitoring of signs of infection can improve neonatal outcomes.[6]

Study Limitations

This study has several limitations that need to be considered. First, the relatively small sample size (n=31) is the main limitation of this study. With 9 events (infants requiring NICU) and 4 independent variables in the logistic regression model, the events per variable (EPV) ratio was only

2.25, far below the recommended minimum of 10 EPV. This causes: (a) inadequate statistical power to detect significant effects in multivariate analysis; (b) possible model overfitting; and (c) unstable odds ratio estimates with very wide confidence intervals. Therefore, the multivariate analysis in this study is exploratory and the main conclusions are based on bivariate analysis results.

Second, the cross-sectional design does not allow for causality assessment. Third, data were collected retrospectively from medical records and thus depend on documentation completeness. Fourth, several important variables in PROM were not included in the analysis, such as duration of membrane rupture (latent period), mode of delivery, and clinical signs of infection (fever, CRP). In this study, the majority of patients underwent cesarean section (26 patients, 83.9%) compared to normal delivery (5 patients, 16.1%).

All patients received prophylactic antibiotics and antenatal corticosteroids according to hospital protocol. These variables were not included due to sample homogeneity (almost all patients received the same intervention), making comparative analysis not possible.

This potentially serves as a confounding factor for neonatal outcomes and needs to be considered in the interpretation of results. Fifth, this study did not control for other confounding variables that may affect neonatal outcomes, such as parity and other maternal medical conditions. Sixth, the distribution of the maternal age variable was not normal based on the Shapiro-Wilk test, although sensitivity analysis results with non-parametric test (Mann-Whitney U) showed consistent conclusions. Prospective studies with larger sample sizes and measurement of additional variables including duration of membrane rupture and clinical signs of infection are needed to confirm these findings.

CONCLUSION

This study demonstrates that birth weight and gestational age are the main determinant factors associated with neonatal outcomes in premature rupture of membranes cases.[1] Infants with lower birth weight and preterm birth have a higher risk of requiring intensive care in the NICU.[2] The relationship between birth weight and infant condition at birth is also confirmed through a strong positive correlation with Apgar scores.[3]

Conversely, maternal factors such as maternal age and leukocyte levels within physiological ranges were not proven to have a significant relationship with neonatal outcomes.[4] Although multivariate analysis showed good prediction accuracy, sample size limitations resulted in no individually significant variables in the model.[5] Therefore, a multifactorial approach integrating fetal weight and gestational age evaluation simultaneously is recommended for optimizing neonatal outcome prediction in the management of premature rupture of membranes cases.[6]

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