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Analysis of Factors Associated with Neonatal Mortality

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ABSTRACT

Neonatal mortality remains a leading cause of infant death despite being a key factor in child health and survival. This study analyzed factors related to neonatal mortality at Rokan Hulu District General Hospital using a quantitative, retrospective case-control approach. The 68 respondents (34 cases, 34 controls) were selected through purposive sampling. Data analysis used a logistic regression model. Prematurity emerged as the most influential variable (p=0.019), carrying a 4.344 times higher risk of neonatal death versus full-term births, after controlling for low birth weight and respiratory distress syndrome.

Keywords: Neonatal Death, Prematurity, Pregnancy Interval, Twin Birth, Asphyxia

1. INTRODUCTION

Neonatal mortality refers to the death of infants within the first 28 days of life. Neonatal mortality is a crucial determinant of child health and wellbeing. However, neonatal mortality rates remain a significant contributor to infant deaths globally, including in Indonesia (Bappenas, 2021). Neonatal mortality is an important indicator of child health and welfare, yet it continues to account for a substantial proportion of infant deaths worldwide and in Indonesia. Reducing neonatal mortality is essential to improving child survival.

Neonatal mortality is caused by maternal and neonatal factors. A systematic review and meta-analysis of risk factors for neonatal mortality in Brazil found that the most significant risk factors were prematurity, which carried 43.46 times higher risk compared to full-term births, and low birth weight, which carried 41.15 times higher risk relative to normal birth weight (Veloso et al., 2019). Another study on determinants of neonatal mortality in Indonesia found that low birth weight was the highest risk factor, with a 12.08 times higher risk compared to normal birth weight (Rumiati and Adisasmita, 2021). In summary, prematurity and low birth weight emerge as major risk factors for neonatal mortality based on research in Brazil and Indonesia. Interventions targeting these factors could help reduce neonatal deaths.

According to research by Budha, Retayasa and Kardana (2016), the most significant risk factors for neonatal mortality were respiratory distress syndrome (RDS), which carried a 16.8 times higher risk, followed by asphyxia with a 13.5 times higher risk. A study by Astria and Windasari (2021) found that sepsis increased the risk of neonatal mortality by 3.23 fold. Erchick et al. (2022) stated that sepsis-related mortality is associated with preterm birth, with preterm infants having a 3.94 times higher risk of sepsis compared to full-term infants. In summary, RDS, asphyxia, and sepsis - especially in preterm infants - emerge as major risk factors from multiple studies on neonatal mortality. Interventions targeting these conditions could help reduce neonatal deaths.

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Other factors causing neonatal mortality include birth spacing of <2 years and multiple births. Mothers with a birth interval of <2 years have a 7.85 times higher risk of neonatal mortality compared to mothers with a birth interval >2 years (Anas et al., 2023). Meanwhile, multiple births carry an 8.53 times higher risk of neonatal mortality compared to singleton births (Alamirew et al., 2022). In other words, short birth intervals and multiple gestation are additional risk factors for neonatal mortality based on recent studies. Interventions to promote optimal birth spacing and manage high-risk multiple pregnancies are important to reduce neonatal deaths.

A preliminary survey conducted by the researcher at the Rokan Hulu District Health Office and Rokan Hulu Regional Public Hospital in 2022 found 56 cases of neonatal mortality. This was an increase compared to 2021, which had 43 cases of neonatal mortality, with the highest number occurring at Rokan Hulu Regional Public Hospital at 46 cases. The remaining neonatal deaths occurred at Surya Insani Hospital (5 deaths), Az-Zahra Hospital (2 deaths), and Awal Bros Hospital (3 deaths). Neonatal mortality cases in Rokan Hulu district increased in 2022 compared to 2021, with most deaths occurring at the regional public hospital. This highlights the need for interventions to reduce neonatal mortality in this region. Based on the background presented above, the researcher is interested in conducting a study entitled "Factors Associated with Neonatal Mortality at Rokan Hulu Regional Public Hospital from January 2021 to June 2023."

2. RESEARCH METHODOLOGY

The method used in this study was quantitative, employing a case-control design with a retrospective approach. The second stage involved qualitative research to further explain the findings from the quantitative study. The population for this study included all neonates hospitalized at Rokan Hulu Regional General Hospital since January, totaling 568 neonates. There were 68 respondents in the case group (neonatal mortality) and 68 respondents in the control group (neonates with prematurity, pregnancy interval <2 years, twin birth, asphyxia, low birth weight, sepsis, respiratory distress syndrome) at Rokan Hulu Regional General Hospital from January 2021 to July 2023. Sampling of the case and control groups was done using non-probability sampling with purposive sampling method. Quantitative data collection was done by reviewing medical records from the period January 2021-June 2023, with inclusion criteria of: complete medical record data and exclusion criteria of: neonates discharged against medical advice and primigravida mothers. The measurement tool used was medical record data at Rokan Hulu Regional Hospital. Data was gathered by reviewing medical records at Rokan Hulu Regional Hospital for the period January 2021-June 2023. Data analysis involved using multiple logistic regression models for prediction. Univariate analysis was done to see the frequency distribution, calculation results and research results presentation in the form of frequency distribution of respondent characteristics, independent variables (prematurity, pregnancy interval, twin birth, asphyxia, low birth weight, sepsis, respiratory distress syndrome) and the dependent variable (neonatal mortality). The bivariate analysis used in this study was chi-square test because the independent variables (prematurity, pregnancy interval, twin birth, asphyxia, low birth weight, sepsis, respiratory distress syndrome) and the dependent variable (neonatal mortality) were categorical variables. The analysis used was Chi-Square with significance of $p < 0.05$. The value used to determine the magnitude of risk in the study was Odds Ratio (OR) because the approach in this study used a Case Control design. The research ethics number was 479/UN.16.2/KEP-FK/2023.

3. RESULTS AND DISCUSSION

Table 1. Univariate analysis

Variable	Case Group		Control Group	
	f	%	f	%
Prematurity				
Premature	33	48.5	14	20.6
Not premature	35	51.5	54	79.4
Pregnancy interval				
< 2 years	18	26.5	10	14.7
≥ 2 years	50	73.5	58	85.3
Twin birth				
Twin	5	7.4	7	10.3

Singleton	63	92.6	61	89.7
Respiratory Distress Syndrome (RDS)				
RDS	35	51.5	21	30.9
No RDS	33	48.5	47	69.1
Asphyxia				
Asphyxia	46	67.6	32	47.1
No asphyxia	22	32.4	36	52.9
Low Birth Weight (LBW)				
LBW	37	54.4	24	35.3
Not LBW	31	45.6	44	64.7
Sepsis				
Sepsis	12	17.6	10	14.7
Tidak Sepsis	56	82.4	58	85.3
Total	**68**	**100**	**68**	**100**

Table 1 shows that in the case group, it can be observed that prematurity contributed 48.5%, pregnancy interval 26.5%, twin birth 7.4%, RDS 51.5%, Asphyxia 67.6%, LBW 54.4%, and Sepsis 17.6%. Meanwhile, in the control group, prematurity was recorded at 20.6%, pregnancy interval 14.7%, twin birth 10.3%, RDS 30.9%, Asphyxia 47.1%, LBW 35.3%, and Sepsis 14.7%.

Table 2. Bivariate analysis

Variable	Case group		Control group		P_{value}	*OR* (95% CI)
	n	%	n	%		
Prematurity						
Premature	33	48.5	14	20.6	0.001	3.637 (1.707-7.746)
No premature	35	51.5	54	79.4		
Total	**68**	**100**	**68**	**100**		
Interval pregnancy						
< 2 years	18	26.5	10	14.7	0.138	2.088 (0.883-4.937)
≥ 2 years	50	73.5	58	85.3		
Total	**68**	**100**	**68**	**100**		
Twin birth						
Twin	5	7.4	7	10.3	0.762	0.692 (0.208-2.297)
Singleton	63	92.6	61	89.7		
Total	**68**	**100**	**68**	**100**		
Asphyxia						
Asphyxia	46	67.6	32	47.1	0.024	2.352 (1.172-4.720)
No Asphyxia	22	32.4	36	52.9		
Total	**68**	**100**	**68**	**100**		
Low Birth Weight (LBW)						
LBW	37	54.4	24	35.3	0.039	2.188 (1.098-4.359)
Not LBW	31	45.6	44	64.7		
Total	**68**	**100**	**68**	**100**		
Sepsis						
Sepsis	12	17.6	10	14.7	0.816	1.243 (0.497-3.106)
Not Sepsis	56	82.4	58	85.3		
Total	**68**	**100**	**68**	**100**		
Respiratory Distress Syndrome (*RDS*)						
RDS	35	51.5	21	30.9	0.024	2.374 (1.178-4.783)
Not RDS	33	48.5	47	69.1		
Total	**68**	**100**	**68**	**100**		

Table 2 shows that the chi-square test demonstrated a significant association between prematurity (p=0.001, OR=3.637), asphyxia (p=0.024, OR=2.352), LBW (p=0.039, OR=2.188), and RDS with neonatal mortality.

Multivariate Analysis

Table 3. Results of bivariate variable selection for Prematurity, Pregnancy Interval, Twin Birth, Asphyxia, LBW, Sepsis, and RDS with Neonatal Mortality at Rokan Hulu Regional Public Hospital from 2021 to 2023.

Independent Variable	p value	note
Prematurity	0.001	Candidate
Interval pregnancy	0.088	Candidate
Twin birth	0.545	Not Candidate
Asphyxia	0.015	Candidate
LBW	0.025	Candidate
Sepsis	0.641	Not Candidate
Respiratory Distress Syndrome (RDS)	0.014	Candidate

Table 3 shows that there are 4 (four) variables that are not associated with neonatal mortality with p values > 0.05, namely the pregnancy interval variable (p-value = 0.143), asphyxia (p-value = 0.067), LBW (p-value = 0.162), and RDS (p-value = 0.191). Therefore, the RDS variable was initially excluded from the multivariate analysis modeling because it had the highest p value. The results of Model II (two) which excludes the RDS variable are as follows.

Table 4. Changes in Odds Ratio (OR) Values After Stepwise Removal of Pregnancy Interval, Asphyxia, and Respiratory Distress Syndrome Variables from Modeling

Independent variable	Changes in OR (%)			
	Not RDS	No LBW	No pregnancy interval	No asphyxia
Prematurity	16.48%	47.15%	6.34%	6.88%

Pregnancy interval	6.15%	6.85%	-	-
Asphyxia	5.09%	16.90%	2.31%	-
LBW	8.47%		9.92%	5.37%
RDS	-	6.10%	5.51%	2.40%

Table 4 shows that the final modeling of factors associated with Neonatal Mortality at Rokan Hulu Regional Public Hospital from 2021 to 2023 can be observed in the following table:

Tabel 5. Pemodelan Analisis Multivariat Akhir Faktor yang Terkait dengan Kematian Neonatal di RSUD Rokan Hulu 2021-2023

Variabel Independen	*p value*	OR	(95%CI)
Prematuritas	0,019	4,344	1,267-14,895
BBLR	0,440	0,635	0,200-2,016
Respiratory Distress Syndrome	0,198	1,662	0,767-3,601

Table 5 shows that the most dominant variable associated with neonatal mortality at Rokan Hulu Regional Public Hospital from 2021 to 2023 was the prematurity variable. Premature infants had a 4.344 times higher likelihood of experiencing neonatal mortality compared to non-premature infants, after controlling for LBW and RDS.

The univariate data showed that neonates in the case group had a much higher incidence rate of diseases such as RDS, asphyxia, and LBW compared to the control group. This underscores the urgency to identify risk factors and take appropriate preventive actions, especially among high-risk populations as found in the case group.

Prematurity is recognized as a critical issue in pregnancy and considered one of the major risk factors for neonatal mortality (Leak et al., 2021). The findings of this study are consistent with previous research (Sulawati 2022), that neonatal mortality was most often found in preterm births, reaching 56.14%, in line with the results of this study. The findings of this study are also consistent with previous research (Egesa et al., 2020), that there is an association between prematurity and neonatal mortality (p = 0.004). Premature infants had a 4.5 times higher likelihood of mortality compared to non-premature infants (OR: 4.5; 95% CI: 1.35–15.31). Two-thirds of premature neonatal deaths occurred within 72 hours after birth, with causes of death being complications of hypothermia (67.2%), RDS (43.0%), Small for Gestational Age (15.7%), and perinatal asphyxia (14.5%), while other cases were caused by other factors such as congenital abnormalities.

Prematurity is considered an extremely important pregnancy issue and one of the major risk factors for neonatal mortality. The relationship between prematurity and neonatal mortality is related to immature physiological functions and limited compensatory responses to the environment outside the womb. Therefore, premature infants face higher risks of morbidities such as hypothermia, perinatal asphyxia, respiratory distress syndrome, apnea, hypoglycemia, jaundice, transient tachypnea, necrotizing enterocolitis (NEC), and challenges in nutritional intake (Astria and Windasari, 2021). A study (Andegiorgish et al., 2020) showed that prematurity was significantly associated with neonatal mortality with an odds ratio (OR) of 6.09. This means prematurity increased the risk of neonatal mortality by 6 times. Mortality associated with prematurity is caused by complications of premature birth, such as surfactant deficiency leading to RDS, intraventricular hemorrhage, necrotizing enterocolitis (NEC), and other complications.

The qualitative research results, through interviews with healthcare personnel and mothers in both case and control groups, revealed that the risk of neonatal mortality was higher in preterm births compared to non-preterm births. Three out of four mothers who gave preterm birth experienced neonatal mortality. Informants stated that 60% of neonatal mortality was caused by complications related to prematurity, especially RDS. According to informants, RDS occurs because the lungs of premature infants are not fully developed, resulting in insufficient surfactant production. As a result, the lungs of premature infants have to work harder to breathe, increasing the risk of lung collapse and neonatal mortality.

The findings from this study are in line with research conducted by (Ermias et al., 2021) in the Neonatal Intensive Care Unit at Debre Markos Referral Hospital in Northwestern Ethiopia, which showed that LBW and prematurity were consistently associated with

neonatal mortality. Premature infants with RDS had a higher mortality risk compared to premature infants without RDS. Similar results were obtained in a study by (Altarhouni, Mohamed and Alhouni, 2023) in the Neonatal Intensive Care Unit at Tobruk Medical Center, Libya, where 61% of neonatal deaths occurred in preterm births. (Gayatri and Irawaty, 2022) On average, premature neonatal mortality occurred within 1 day to 7 days of treatment in the Neonatal Intensive Care Unit. (De Luca et al., 2022) The main causes of death in premature infants were RDS, congenital abnormalities, and respiratory infections.

Altarhouni, Mohamed and Alhouni (2023) stated that premature infants are physiologically immature and have limited compensatory responses to the environment outside the womb. Therefore, they have a higher risk of morbidities such as hypothermia, perinatal asphyxia, RDS, apnea, hypoglycemia, jaundice, transient tachypnea, patent ductus arteriosus, intracranial hemorrhage, necrotizing enterocolitis (NEC), and feeding difficulties. Premature infants also tend to require longer hospital stays. (Egesa et al., 2020) also mentioned that infants born prematurely are more likely to receive longer care, thus increasing the risk of nosocomial infections in hospitals.

The birth of premature infants carries a high risk of neonatal mortality and various health complications such as hypothermia, respiratory problems, and infections. Preterm birth is considered a serious trigger for the risk of neonatal mortality, where the organs of the infant are not yet fully mature to cope with conditions outside the womb (Mogi and Anggraeni, 2021). This situation can lead to hypothermia, respiratory problems, and an increased risk of infection in the neonate (Kannaujiya et al., 2022).

CONCLUSION

There is an association between prematurity and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. There is no association between pregnancy interval and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. There is no association between twin birth and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. There is an association between Respiratory Distress Syndrome (RDS) and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. There is an association between asphyxia and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. There is an association between Low Birth Weight (LBW) and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. There is no association between sepsis and neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023. The variable with the most dominant relationship to neonatal mortality at Rokan Hulu Regional Public Hospital 2021-2023 is the prematurity variable.

SUGGESTIONS

The Rokan Hulu District Government is expected to strive to reduce neonatal mortality rates by improving MCH, family planning and early detection of risk factors as well as completing PONEK and PONED facilities, infrastructure and facilities.

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