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Distributions and Determinants of Neonatal Mortality in Rembang Regency, Central Java Province, Indonesia

Yovita Oga Odelia[1], Sani Rachman Soleman[1]✉

[1]Department of Public Health, Faculty of Medicine, Universitas Islam Indonesia

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Abstract

Neonatal mortality in Rembang regency, Central Java province, has raised concerns to solve comprehensively. This study aimed to observe and analyze distributions and examine determinants of neonatal mortality in the Rembang regency. A case-control study was conducted to examine 50 cases and 50 control by the medical records in the Department of Health. There were 11 variables: parity, mother's age, gestational age, a congenital defect, neonatal sepsis, neonatal asphyxia, pregnancy complication, birth weight, labour locations, childbirth helper, and type of labour. The analysis consists of bivariate with chi-square and multivariate by logistic regression. The most frequent risk factors are gestational age (P=0.00; OR=18.4; and CI=5.04-67.00) and birth weight (P=0.00; OR=14.7 and CI=4.96-43.51), yet logistic regression found high-risk birth weight (P=0.01; aOR=5.4 and CI=1.43 – 20.34) and high-risk gestational age (P=0.03; aOR=5.8 and CI=1.22-27.59) are significant on neonatal mortality in Rembang regency, Central Java Indonesia. This finding is essential in taking policy action on safe pregnancy among high-risk women in the Rembang regency.

INTRODUCTION

The children and neonatal mortality rate reflect each country's welfare as an indicator of economic, health and life expectancy (Miladinov, 2020). Consequently, policymakers should handle it via regulation and rule, particularly in developing countries such as Indonesia. Indonesia is one of few countries worldwide that has reached Millennium Development Goals (MDGs) of decreasing neonatal, under-five and children by two-thirds between 1990 to 2015; in particular under-five mortality rate has dropped from 85 to 27 death per 1000 live births (Ahmed et al., 2019). To terminate this issue, Sustainable Development Goals (SDG) target for 2016-2030 in Indonesia plans to accomplish neonatal mortality of 12 per 1000 live births and under-five age mortality of 23 per 1000 live births (UNICEF, 2021). In Central Java province, neonatal death was 7.2 per 1000 live births, and infant mortality was 10 per 1000 live births; despite declining from previous years, the result was insignificant (Adashi et al., 2014). Several regencies remain above the national target, including the Rembang regency. According to Health Office Rembang regency, the fluctuation rate of neonatal mortality was around

✉ Corespondence Address:
Departement of Public Health, Faculty of Medicine
Universitas Islam Indonesia
E-mail: sani.rachman@uii.ac.id

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90 to 92 in 2015 and 2016; moreover, in 2017, the proportion reached the highest level at 107 death.

World Health Organization (WHO) has determined four primary aspects of neonatal mortality: maternal, neonatal, health services and socio-economic factors (Abdullah et al., 2016; Neal et al., 2018; Zhao et al., 2020). Maternal factors related to neonatal death were caused by underlying diseases contributing to pregnancy complications (Ndayisenga, 2016). Mothers with chronic diseases such as kidney disease, hypertension and diabetes have high-risk morbidity and mortality during labor (Grandi et al., 2015; Huang et al., 2022; Nuccio & Chonchol, 2016). The most life-threatening experience is ante or post-postpartum hemorrhage, which is significantly related to neonatal or maternal death (Hough et al., 2021). Furthermore, mothers less than 20 or more than 35 years old are associated with high mortality due to the maturity of reproduction organs, physical endurance, and psychosocial effect on maternal aspects (Kim et al., 2021; Leal et al., 2018).

The neonatal factor is a principal component that contributes to death in infants. The most often are congenital disease, low birth weight, and neonatal asphyxia (Gilboa et al., 2016). In addition, heart defect-induced morbidity among infants due to uncompensated body physiology again septum or valve formation defects aggravated by Eisenmenger syndrome (Alves et al., 2018; Gilboa et al., 2016). Low birth weight is a common problem, particularly in rural or isolated areas, due to education and economic background reasons (Chiera & Pradono, 2016). Moreover, nutrient status reflects the health status that should be fulfilled by the mother during pregnancy to prevent low birth weight (Sangi et al., 2021). Macro or micronutrients during pregnancy are essential to the development of the brain, stimulus of neurons, and growth of intellectual ability (Sangi et al., 2021).

Health services are one of the aspects associated with neonatal mortality (Abdullah et al., 2016). Three elements of health services should be concerned, health officer or childbirth helper, location of labour and type of labour. In addition, health services are related to equality issues in rural, urban and remote areas. This aspect requires a solid policy by the government and supporting efforts by the community itself. Since the problems of neonatal mortality are multi-factorial, tight regulation is warranted to terminate this situation. Hence, this study aims to disclose the distribution of neonatal mortality in the Rembang regency, as well determinants factors of it. By declaring these issues, the neonatal mortality rate in the Rembang regency should be able to diminish near future.

METHOD

Study Design

A case-control design was used to search for correlation among variables with the consecutive sample to collect respondents. According to the calculated sample size, 100 respondents consisting of 50 cases and 50 control were obtained across the Rembang regency. Since we used secondary data to collect the respondents, the case criteria were neonates who died less than 28 days of life, and the control criteria were neonates who lived after delivery from 0 days to 28 days. The criteria for 28 days was based on the definition of neonates by the Ministry of Health Republic Indonesia (Ministry of Health., 2014). The exclusion criteria were missing information and incomplete record regarding baseline characteristics and neonatal complications. The calculation sample size used two proportions by Odd Ratio (OR) at 9.2 (Susanti et al.,2016), presented in this formula below.

$$n1 = n2 = \frac{(Z\alpha\sqrt{2PQ}+Z\beta\sqrt{P1Q1+P2Q2})^2}{(P1-P2)^2}$$

$$n1=n2= \frac{(1,96\sqrt{2.0,26.0,74}+0,84\sqrt{0,44.0,56+0,08.0,92})^2}{(0,44-0,08)^2} = 22$$

The minimal sample size in our study was 22. In anticipation of dropping out, we added the size to more than double to 50. Thus, the sample for the case was 50, and the control was 50.

Data Collection

The data were collected via medical records in the Health Office, Rembang Regency and community health center (Puskesmas). There were eight Puskemas, such as Kaliori, Rembang I, Sedan, Sarang I, Sarang II, Sluke, Bulu and Pancur. We selected those Puskesmas due to the case of the neonatal mortality rate was higher than others. The collected data were neonates who were born and registered in the medical record from January 1 to December 31, 2017. At the baseline characteristic obtained 11 variables that must be analyzed descriptively and categorized into a few aspects such as parities (1, 2-3 and > 4); mother's age (< 20, 20-35 and > 35 years old); gestational age(< 37, 37-42 and > 42 weeks); congenital defects consists of heart defect, pulmonary defect, intestine strictture, other defects and no defects, neonatal sepsis and neonatal asphyxia; pregnancy complications

such as preeclampsia, fever, infection, gemelli, breech presentation, cephalo-pelvic disproportions, upper arm circumference, HIV infection, anemia and no complication; birth weight was categorized into > 4000 gram, 2500-4000 gram, 1500-2499 gram, 1000-1499 gram, < 1000 gram; labor locations were hospital, community health services, clinic and house; childbirth helpers were medical doctor and midwife, and types of labor were spontaneous and cesarean. Therefore, only six variables were identified as most eligible to continue in chi-square tests such as parities (high risk and no high risk), age of mother (high risk and no high risk), gestational age (high risk and no high risk), pregnancy complications (yes and no), birth weight (high risk and no high risk) and type of labor (spontaneous and cesarean operation).

Statistical Analysis

We presented pseudo R square, Hosmer and Lameshow Test and regression equation multivariate analysis. All variables were analyzed with the chi-square technique and continued with logistic regression with SPSS version 23. The chi-square analysis was performed in categorical data, and logistic regression was set at 0.05 and 95% confidence intervals. Ethical approval was proposed to the Faculty of Medicine, Universitas Islam Indonesia number 45/Ka.Kom.Et/70/KE/V/2018.

RESULTS AND DISCUSSION

Neonatal mortality is the most attention issue in the Rembang regency. Table 1 describes parities 2-3 (62%), mother's age 20-35 years old (83%), gestational age 37-42 weeks (71%), no congenital defects (86%), no neonatal sepsis (93%), no neonatal asphyxia (86%), no pregnancy complications (84%), normal birth weight 2500-4000 gram (63%), labor locations in community health services (52%), midwives as childbirth helper

Table 1. Distribution of variables neonatal mortality (n 100)

Variables	Cases		Control		n	
	n	%	n	%	n	%
Parities						
1	12	12	21	21	33	33
2-3	33	33	29	29	62	62
≥4	5	5	0	0	5	5
Age of Mother (Yr)						
<20	0	0	3	3	3	3
20-35	43	43	40	40	83	83
>35	7	7	7	7	14	14
Gestational Age (Wk)						
<37	26	26	3	3	29	29
37-42	24	24	47	47	71	71
>42	0	0	0	0	0	0
Congenital Defects						
Heart Defects	3	3	0	0	3	3
Pulmonary Defects	1	1	0	0	1	1
Intestine Stricture	1	1	0	0	1	1
Other Defects	9	9	0	0	9	9
No Defects	36	36	50	50	86	86
Neonatal Sepsis						
Sepsis	7	7	0	0	7	7
No Sepsis	43	43	50	50	93	93
Neonatal Asphyxia						
Asphyxia	14	14	0	0	14	14
No Asphyxia	36	36	50	50	86	86

Variables	Cases		Control		n	
	n	%	n	%	n	%
Pregnancy Complications						
Preeclampsia	1	1	0	0	1	1
Fever	1	1	0	0	1	1
Infection	1	1	0	0	1	1
Gemelli	1	1	0	0	1	1
Breach presentation	0	0	1	1	1	1
CPD	0	0	1	1	1	1
UAC <23,5 cm	0	0	5	5	5	5
HIV (+)	0	0	1	1	1	1
Hemoglobin <11	0	0	4	4	4	4
No Complications	46	46	38	38	84	84
Birth Weight (Gram)						
MBW (>4000)	0	0	3	3	3	3
NBW (2500-4000)	18	18	45	45	63	63
LBW (1500-2499)	20	20	2	2	22	22
VLBW (1000-1499)	10	10	0	0	10	10
ELBW (<1000)	2	2	0	0	2	2
Labor Locations						
Hospital	31	31	10	10	41	41
Community Health Services	14	14	38	38	52	52
Clinic	4	4	2	2	6	6
House	1	1	0	0	1	1
Childbirth Helper						
Midwives	32	32	38	38	70	70
Medical Doctors	18	18	12	12	30	30
Types of Labor						
Spontaneous	40	40	43	43	83	83
Sectio Cesarean	10	10	7	7	17	17

(CPD = cephalo-pelvic disproportion, UAC = upper arm circumference, HIV = human immunodeficiency virus, MBW = more birth weight, NBW = normal birth weight, LBW= low birth weight, VLBW= very low birth weight, ELBW= extreme low birth weight)

(70%) and types of labor spontaneous (83%).

According to descriptive data, only six variables continued for bivariate analysis. The variables are parities, mother's age, gestational age, pregnancy complications, birth weight and types of labor; the remaining variables are excluded because of disproportioned or minimal data between case and control.

Table 2 shows three variables of gestational age and birth weight significantly correlated with neonatal mortality. Nevertheless, other variables are not associated. Several variables are not evaluated in this study, such as nutritional status during pregnancy, environmental conditions, and health accessibility. We suggest undertaking a comprehensive evaluation covering all neonatal mortality factors.

According to table 3, high-risk birth weight (< 2500 grams and > 4000 grams) and high-risk gestational age(< 37 weeks and > 42 weeks) are predictors of neonatal mortality compared to low-risk birth weight and low-risk gestational age. In addition, high-risk birth weight and gestational ages offer 5.4 and 5.8 incidences of neonatal death in Rembang regency, Central Java, Indonesia. Cox and Snell R square and Nagelkerke R square obtain 0.3 and 0.41, respectively. In the last step of logistic regression, both variables can explain

Table 2. Determinants of neonatal mortality

Variables	Neonatal Mortality				n		P value	OR	CI 95%
	Cases		Control						
	n	%	n	%	n	%			
Parities									
High-Risk	17	17	21	21	38	38	0.54	0.7	0.31-1.60
No High-Risk	33	33	29	29	62	62			
Age of Mother									
High-Risk	8	8	10	10	18	18	0.80	0.8	0.27-2.13
No High-Risk	42	42	40	40	82	82			
Gestational Age									
High-Risk	27	27	3	30	30	30	0.00*	18.4	5.04-67.0
No High-Risk	23	23	47	47	70	70			
Pregnancy Complications									
Yes	4	4	12	12	16	16	0.70	0.5	0.08- 0.92
No	46	46	38	38	84	84			
Birth Weight									
High-Risk	31	31	5	5	36	36	0,00*	14.7	4.96- 43.51
No High-Risk	19	19	45	45	64	64			
Type of Labor									
Cesarean	10	10	7	7	17	17	0.59	1.6	0.53-4.42
Spontaneous	40	40	43	43	83	83			

* p value significant < 0.05

High-risk parity is less than 2 and more than 3; high-risk of the mother is less than 20 yo and more than 35 yo; high-risk gestational age is less than 37 and more than 42 weeks; high-risk birth weight is less than 2500 and more than 4000 grams.

Table 3. Model logistic regression determinants of neonatal mortality

Variabel	P- value	OR adjusted	CI 95%
High-Risk Birth Weight	0.01	5.4	1.43-20.34
High-Risk Gestational Ages	0.03	5.8	1.22-27.59

neonatal mortality at 30% and 41% in this study. Additionally, Hosmer and Lameshow Test found p=0.1 which concluded that this model is suitable for this study. The logistic regression equation is presented below.

Ln= -0.957+ β 1.75 (high-risk gestational ages)+ β 1.68 (high-risk birth weight)

This study finds that the high risk of birth weight and gestational age are the most significant predictor of mortality. A similar study elucidated that preterm gestational age and low birth weight were risk factors for mortality (Getiye & Fantahun, 2017). An additional study by Cavallin et al. reported that birth weight was statistically significant with the incidence of neonatal mortality (Cavallin et al., 2020). Both studies noted that most causes of neonatal mortality are preventable. However, determinants of neonatal mortality are not only focusing on neonatal and maternal per se, such as presented by Abdullah et al. Their studies recorded that neonatal mortality was multi-factorial such as knowledge of mothers, health facility accessibility, and poverty indicator (Abdullah et al., 2016). It is imperative to note that this situation is ruthless to be solved in short-term action; multi-sectoral approaches warrant handling this issue.

One aspect of neonatal factors is congenital anomalies. It is noted that Indonesia was the number one neonatal mortality in the South

East Asian countries from 2000 to 2017 (Soleman, 2020). However, most congenital are not life-threatening, such as talipes equinovarus and orofacial cleft. Congenital heart disease, however, is the most life-threating that should be managed (Soleman, 2020). In our study, congenital anomalies are 14%, and three cases of congenital heart disease. Hence, we excluded congenital anomalies because there was minimal data to continue the analysis. Leak et al. recorded that congenital heart was associated with neonatal death at more than 37 weeks of gestation (Leak et al., 2021). Further study is granted to observe the prospective correlation of congenital anomalies, particularly congenital heart disease, as a risk factor for neonatal death.

The maternal complication is one the most lethal in neonatal death. However, Khanam et al. reported that antepartum complications such as antepartum haemorrhage, infection and hypertension correlated with stillbirth and neonatal and perinatal death (Khanam et al., 2017). Therefore, it is commanding to state that the maternal factor is life-threatening for either mother or neonate. Ministry of Health Indonesia has declared an antenatal service guideline to prevent maternal and neonatal death (Kementrian Kesehatan RI, 2020). The guideline elucidated the examination, recording and evaluation safety of pregnancy. However, our study has stated that infection is the most common case, while nutrition issues are the most common in control groups. Maternal factors have undoubtedly affected the outcome of birth; further study is imperative to disclose the association between maternal complications in neonatal mortality.

The health services aspect correlated with neonatal death, distance to community health services, time to community health services, poverty variables, and social support have proven as predictors of neonatal death, as Abdullah et al. reported (Abdullah et al., 2016). Their study was conducted in a rural area in Indonesia, where facilities, infrastructure, and healthcare distribution were challenging. However, our study found that most mothers had delivered in health facilities and handled by a healthcare professional. Therefore, a comprehensive analysis of non-maternal and neonatal factors could give insight into neonatal death in the community.

LIMITATION

This study has several limitations. First, medical records could not reflect actual neonatal mortality data due to bias in collecting data. Also, medical records are limited information on incidents and the proportion of cases and outcomes. Second, the case-control study design could not calculate an incidence rate to predict the case and outcome. Further study should handle many cases by prospective study design in rural, urban and suburban areas with various variables.

CONCLUSION

Neonatal mortality incidence threatens to achieve Sustainable Development Goals (SDG). Because of the multi-factorial causes, it is crucial to take action multi-sectoral in handling it. Our study demonstrated that the neonatal mortality rate in Rembang regency reached 107 cases in 2017. The cases were affected by high-risk birth weight and high-risk gestational ages. Both factors offered more significant contributions than others. Since most causes of neonatal mortality are preventable, the government should take action to prevent neonatal death, particularly from both aspects.

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