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The Risk Factors of Neonatal Mortality in Pekanbaru City, Indonesia

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Abstract

BACKGROUND: Neonatal mortality is death during the first 28 days of life, expressed per 1000 live births. In 2020, there was an increase in the number of neonatal mortality from 50 infant to 115 infant in Pekanbaru City, Indonesia.

AIM: The study objective was to analyze factors associated with neonatal mortality in the Pekanbaru City, Indonesia.

METHODS: The sample was 220, consisting of 110 case and 110 control samples. The total sampling technique was used for case and systematic sampling for control samples. The variables analyzed were mother's age, mother's education, parity, birth spacing, gestational age, birth weight, and antenatal care. Data were analyzed by multiple logistic regressions.

RESULTS: The results showed that the risk factors for neonatal mortality were antenatal care < 4 times (OR = 8.2; 95% CI = 4.0−17.1), gestational age < 35 weeks (OR = 5.5; 95% CI = 2.2–14.0), mother's < 20 years or > 35 years (OR = 3.1; 95% CI = 1.3−7.1), and birth spacing < 2 years (OR = 2.6; 95% CI = 1.2−5.7).

CONCLUSION: The antenatal care, gestational age, mother's age, and birth spacing are preventable or possibly preventable risk factors. As a recommendation, the Health Office of Pekanbaru and Community Health Service should increase promotion of antenatal care for pregnant women and family planning to preserve birth spacing for women of childbearing age.

Introduction

Neonatal mortality is deaths during the first 28 days of life, expressed per 1000 live births. Neonatal period is the most vulnerable period for the survival of a child. Infants face the highest risk of death in their first month of life. In 2019, for comparison, the average neonatal death was 17 deaths per 1000 live births, the probability of dying after the 1st month and before reaching the age of 1 year was estimated at 11 deaths per 1000, and the probability of dying after reaching the age of 1 and before reaching the age of 5 years was estimated at 10 deaths per 1000. Globally, 2.4 million children died in the first month of life in 2019 or about 6700 neonatal deaths every day. About one-third of all neonatal deaths occur within the 1st day after birth, and nearly, three-quarters occur within the 1st week of life [1].

The results of the Indonesian Demographic and Health Survey (IDHS) in 2017 showed that the neonatal mortality rate in 2017 was 15 per 1000 live births, down from 19 in 2012. In 2019, based on data from the Health Profile of the Indonesian Ministry of Health, the total under-5 mortality rate (IMR) including neonatal mortality was 49,566, there are five provinces with the highest percentage of IMR, namely, Central Java (16.78%), East Java (14.56%), West Java (10.93%), Banten (4.99%), and Aceh (3.488%). Riau Province was ranked 17th with a total of 901 deaths (1.82%). If the IMR in an area is high, it means that the health status in that area is low [2].

In Pekanbaru City, neonatal mortality was increase in 2020. In 2019, the number of neonatal deaths was 50, while in 2020, the number of neonatal mortality was 115 [3]. Neonatal mortality in Pekanbaru City was spread across 21 Community Health Center (Puskesmas). The highest neonatal mortality occurred at the Payung Sekaki Health Center with 21 cases (24%), while the Puskesmas that did not have any neonatal mortality cases was the Muara Fajar Health Center. Based on the interviews with the person in-charge of the Maternal and Child Health Program at the Pekanbaru City Health Office, it was found that there was a spike in neonatal mortality due to reporting of mortality data from private hospitals that were well coordinated compared to previous years.

Many studies found that neonatal mortality influenced with multiple factors, among the risk factors associated with neonatal mortality, was mother's age during pregnancy, parity, birth spacing, gestational age, birth weight, and antenatal care. The risk of neonatal death was greater in mothers aged less than 16 years [4], mothers aged < 20 years had a risk of neonatal mortality of 1.6 times (95% CI: 1.1–2.4) [5], and mother age ≥ 35 years had a risk of neonatal mortality 1.6 (%95 CI

1.1–2.2) [6]. Parity > 3 had a risk to neonatal mortality 8.0 (95% CI: 1.7–37.7) [7], another study showed parity ≥ 3, and mother's age 18–<35 years had a risk to neonatal mortality 1.3 (95% CI: 1.1–1.5) compared with parity 1–2 and mother's age 18–<35 [8].

The faster the gap between preceding birth and current birth, the greater the risk of neonatal death. Birth spacing < 18 months had a risk of neonatal mortality 2.3 (95% CI 2.18–2.37), birth spacing 18–<23 months had a risk of neonatal mortality 1.33 (1.27, 1.39) compared to birth spacing 18–24 months [9], and another study showed infant born < 2 years of the preceding birth had hazard ratio 2.19 (95% CI: 1.9–2.5) compared to infant born ≥ years [10].

The previous studies found that gestational age <37 weeks had a risk of neonatal mortality. In Jordan, it found that gestational age < 37 weeks had a risk of neonatal mortality with OR 23.8 (95% CI: 17.4–32.5) [5] and in Brazil 7.130 (95%CI: 4.3-11.7) [5], [6]. Infants with 34 weeks of gestation had the highest rate of neonatal mortality (OR = 58.7; 95% CI 28.4–121.4) compared to infants with 37 weeks of gestation in East Africa [11].

Infant with birth weight < 1500 g had a risk of neonatal mortality higher (OR = 40; 95% CI: 29.0–55.1) than between 1500 and 2499 g (OR = 5.4; 95% CI: 4.1–7.1) [6]. Others study showed that birth weight < 2500 g had odds ratio 6.5 (3.00–14.05) [12] and adjusted RR 3.1 (1.5–6.6) [13].

In Indonesia, antenatal care (ANC) carried out at least 4 times [14]. A study in Eastern Uganda showed that ANC 4 times and above had adjusted RR 0.65 (0.43–0.98) [13]. A study in Jordan used categorize ANC 8 times, it was found that ANC 1–8 times had a risk of neonatal mortality 1.9 (1.5, 2.5) [5].

The objective of this study was to analyze the risk factors for neonatal mortality in Pekanbaru City. The results of the study were expected to provide information associated to neonatal mortality, and policy in the prevention of neonatal mortality and recommendation in improving the health of pregnant women in Pekanbaru City.

Methods

The study was conducted in Pekanbaru City. The design of the study was case control. The case population was all data of neonatal mortality (0–28 days) in 2020 that recorded on the neonatal death autopsy form at the Pekanbaru City Health Office, amounting to 115. The control population was infants who were still alive until they passed the neonatal period that recorded in the cohort of births data at the community health service in the work area of the Pekanbaru City Health Office, which amounted to 2128 infants.

The case exclusion criteria were the incomplete neonatal death autopsy form data. The control exclusion criteria were incomplete birth cohort data. The number of cases in this study was 110 infants and the number of controls was 110 infants. There were five data from case sample that had not birth space variable. The case sampling technique was total sample and the control sampling technique was systematic random sampling.

The variables used in this study were variable that available on both the autopsy form of death and the birth cohort. The variables were mother's age, mother's education, parity, gestational spacing, gestational age, birth weight, and antenatal care. Maternal age was categorized as at risk if aged < 20 years and > 35 years and not at risk if aged 20–35 years. Mother's education was categorized as low if junior high school or below and high if high school or above. Parity was the number of children ever born to a mother, either living or dead, categorized as at risk if parity ≥ 3 and not at risk if parity < 3. Gestational spacing was the distance between the previous child's birth and the sampled child, categorized as at risk if birth spacing < 2 years and not at risk if the birth spacing is 2 years. Gestational age was categorized as at risk if the gestational age was <37 weeks or > 42 weeks and not at risk if the gestational age was 37–42 weeks. Birth weight was categorized as at risk if the baby's weight was <2500 g and not at risk if the baby's weight was 2500 g. Antenatal care was an examination carried out by the mother during pregnancy to optimize the mental and physical health of pregnant women so that they are able to face childbirth, the postpartum period, preparation for breastfeeding, categorized as at risk if < 4 times, and not at risk if ≥ times.

Data were analyzed using frequency distribution, Chi-square, and multivariate logistic regression.

Ethical clearance for the study was granted from the Ethics Committee of the STIKes Hang Tuah Pekanbaru, number 460/KEPK/STIKes-HTP/IX/2021.

Results

Table 1 shows the causes of mortality and the time of neonatal mortality. The two main causes of neonatal mortality were asphyxia and low birth weight. There was still unexplained neonatal mortality. Most neonatal mortality was occurred in the 1–3 days period, with a range of 2 h after birth to 22 days of birth.

Characteristics sample is shown in Table 2. Most of the mothers were in the age range of 20–35 years, mothers from the case group that aged >35 years were almost 3 times more than the control group. Most of the mothers had high school education. Mothers with college education were more in the control group. The range of parity 1–5, more than half of the mothers from

Table 1: The causes and time of neonatal mortality

The causes and time of neonatal mortality	n (%)
The causes of mortality	
Asphyxia	44 (40.0)
Low birth weight	33 (30.0)
Congenital anomalies	12 (10.9)
Sepsis	10 (9.1)
Unexplained	11 (10.0)
Time of mortality (days)	
< 1	18 (16.4)
1–3	46 (41.8)
4–6	20 (18.2)
>6	26 (23.6)

Table 2: Characteristics of case and control groups

Characteristics	Case, n (%)	Control, n (%)
Mother's age (years)		
<20	3 (2.7)	2 (1.8)
20–35	80 (72.7)	98 (89.1)
>35	27 (24.5)	10 (9.1)
Education		
Elementary	8 (7.3)	7 (6.4)
Junior	35 (31.8)	35 (31.8)
Senior	60 (54.5)	53 (48.2)
College	7 (6.4)	15 (13.6)
Parity		
1	9 (8.2)	28 (25.5)
2	42 (38.2)	61 (55.5)
3	49 (44.5)	19 (17.3)
4	9 (8.2)	0
5	1 (0.9)	2 (1.8)
Birth spacing (years)		
<1	2 (1.8)	0
1	34 (30.9)	18 (16.4)
2	49 (44.5)	43 (39.1)
3	14 (12.7)	21 (19.1)
>3	11 (10.0)	28 (25.5)
Gestational age (weeks)		
28–32	12 (10.9)	1 (0.9)
33–36	21 (19.1)	8 (7.3)
37–42	77 (70.0)	101 (91.8)
Birth weight (g)		
2100–2400	38 (34.5)	12 (10.9)
2500–2900	48 (43.6)	59 (53.6)
≥3000	24 (21.8)	39 (35.5)
Antenatal care (times)		
1	5 (4.5)	1 (0.9)
2	46 (41.8)	13 (11.8)
3	44 (40.0)	36 (32.7)
4	15 (13.6)	60 (54.4)

the control group had parity 2, while in the case group, the largest proportion was with parity 3.

The range of birth spacing was 0.7–6 years, the proportion with a birth spacing of 1 year in the case group was almost twice as compared to the control group, the opposite was come about for birth spacing >3 years. Gestational age varied from 28 to 42 weeks. The proportion of cases group with gestational age <36 weeks was more than 3 times. The lowest birth weight was 2100 g and the highest was 4000 g. Most of the samples were in the birth weight range of 2500–2900 g. The ANC range from 1 to 4 times, more than half of the mothers in the control group performed ANC 4 times, on the contrary in the case group, only 13.6% of mothers performed ANC 4 times.

The bivariate analysis of the variables associated with neonatal mortality is shown in Table 3. The number of risk factors that analyzed was 7, of the seven variables, only maternal education was not associated with neonatal mortality. The variable that has the greatest OR value was antenatal care, mothers who have pregnancy examination < 4 times during pregnancy have a 7.6 times risk for their baby to experience neonatal mortality compared to mothers who have ≥ 4 pregnancy examination during pregnancy.

The results of the multivariate analysis of risk factors associated to neonatal mortality are shown in Table 4. Factors that were significantly associated with neonatal mortality were antenatal care, gestational age, mother's age, and birth spacing. Similar to bivariate analysis, antenatal care has the largest OR value among other variables. Mothers who underwent antenatal care < 4 times during pregnancy had a risk of 8.2 times for their babies to experience neonatal death compared to mothers who underwent antenatal care 4 times during pregnancy.

Birth weight was confounding factors gestational age and antenatal care, parity confounding factor for gestational age. The variables were not significantly associated with neonatal mortality, which were mother's education, parity, and birth weight. The results of Nagelkerke R square showed that the variables of mother's age, birth spacing, gestational age, and antenatal care could explain 39.8% of neonatal mortality, the rest was explained by other variables not studied.

Discussion

Most of neonatal mortality in Pekanbaru City (76.4%) were occurred before the age of 1 week, showing the same condition that happened globally. It was three-quarters of neonatal mortality occurred in the 1st week after birth [1]. The main cause of mortality was asphyxia followed by low birth weight. The previous study has also found that asphyxia is the main cause of neonatal mortality [7], [15]. Neonatal asphyxia according to the Indonesian Pediatrician Association (2014) is the failure of a baby to breathe spontaneously and regularly at birth or shortly after birth which is characterized by hypoxemia, hypercarbia, and acidosis [16]. This can be due to fetal hypoxia in the uterus associated with factors that arise during pregnancy and childbirth.

Antenatal care is pregnancy examination that carried out at least 4 times during pregnancy, namely, one examination in the first trimester, one examination in the second trimester, and two examinations in the third trimester [14]. The study showed that mothers who underwent antenatal care < 4 times during pregnancy had a risk of 7.6 times for their babies to experience neonatal mortality compared to mothers who underwent antenatal care 4 times during pregnancy. The previous studies that conducted in East Uganda used similar categorized with the present study found the ANC 4 times and above had adjusted RR 0.65 (0.43–0.98) [13]. Pregnancy examination is carried out to determine the health of pregnant women and the development of the baby that they are carrying so that they are expected to achieve optimal health to face the period of labor, puerperium, and lactation. In addition, pregnant women are expected to have adequate knowledge about the care of their babies.

Table 3: Bivariate analysis of the association of risk factors to neonatal mortality

Risk factors	Neonatal mortality			p	OR (95% CI)
	Case, n (%)	Control, n (%)	Total, n (%)		
Mother's age (years)					
<20 and >35	30 (71.4)	12 (28.6)	42 (100.0)	0.002	3.063 (1.473−6.366)
20–35	80 (44.9)	98 (55.1)	178 (100.0)		
Mother's education					
Junior high or below	43 (50.6)	42 (49.4)	85 (100.0)	0.890	1.039 (0.604−1.788)
Senior high or above	67 (49.6)	68 (50.4)	135 (100.0)		
Parity					
≥3	10 (83.3)	2 (16.7)	12 (100.0)	0.018	5.400 (1.155−25.248)
<	100 (48.1)	108 (51.9)	208 (100.0)		
Birth spacing (years)					
<2	36 (67.9)	17 (32.1)	53 (100.0)	0.003	2.661 (1.386−5.111)
≥2	74 (44.3)	93 (55.7)	167 (100.0)		
Gestational age (weeks)					
<37	33 (78.6)	9 (21.4)	42 (100.0)	0.000	4.810 (2.173−10.645)
37–42	77 (43.3)	101 (56.7)	178 (100.0)		
Birth weight (g)					
<2500	38 (76.0)	12 (24.0)	50 (100.0)	0.000	4.310 (2.105−8.826)
≥2500	72 (42.4)	98 (57.6)	170 (100.0)		
Antenatal care (times)					
<4	95 (65.5)	50 (34.5)	145 (100.0)	0.000	7.600 (3.923−14.724)
≥4	15 (20.0)	60 (80.0)	75 (100.0)		

OR: Odds ratio, CI: Confidence interval.

Table 4: Multivariate analysis of the association of risk factors to neonatal mortality

Risk factors	p	OR	95% CI for EXP (B)	
			Lower	Upper
Antenatal care <4 times	0.000	7.355	3.501	15.453
Gestational age <37 weeks	0.006	3.986	1.476	10.761
Mother's age <20 or >35 years	0.022	2.703	1.152	6.339
Birth spacing <2 years	0.026	2.492	1.113	5.581
Birth weight <2500 g[a]	0.086	2.087	0.902	4.826
Parity ≥3[b]	0.190	3.488	0.538	22.595

[a]The birth weight of the baby was a confounding variable for gestational age and antenatal care, [b]parity was a confounding variable for gestational age. Omnibus test of model coefficient = 0.000, Nagelkerke R^2 = 0.398. OR: Odds ratio, CI: Confidence interval.

Gestational age <37 weeks was a risk factor in this study. Mothers who are <37 weeks pregnant have a 5.5 times risk for their baby to experience neonatal mortality compared to mothers with a gestational age of 37–42 weeks. Infant born at the age of < 37 weeks is called premature, in the case group, 33 (30.0%) infants were born prematurely while in the control group only 8.1%. Prematurity in infants is a risk condition because it has an impact on neonatal mortality, the shorter the gestation period, the less of the growth period of the fetus's organs that make them more susceptible to complications. A study conducted in Sweden showed that the proportion of infants born prematurely (<37 weeks) who died in the 1st year of life was 8.6%. Infants born at week 22–week 27 who experienced mortality were 70.7%, infants born at weeks 28 to 33 were 18.4%, and infants born at weeks 34–36 were 3.1%, while infant born at term at 37–42 weeks experienced only 0.7% of neonatal mortality [17]. Other studies also find similar finding [5], [6], [11].

Mother's age which is a risk factor for neonatal death is <20 years or >35 years. In this study, more mothers aged> 35 years. Velozo *et al*. found alike result with the present study, age ≥ 35 years had a risk of neonatal mortality 1.6 [6]. Infant who born from younger mother (aged <20 years) can cause premature birth, low birth weight, fetal distress, and congenital defects that cause neonatal death. Likewise, infant who born from older mother (aged > 35 years) also can experience death because the physiological adaptation more severe during the pregnancy, physical, and reproductive organs had declined even though their mental and socioeconomic conditions were more stable. Gestational age over 35 years increases the risk of placenta previa because the endometrial growth is less fertile, causing complications to the fetus and causing neonatal mortality [18].

The WHO recommends that birth spacing 24–36 months between pregnancies to reduce fetal, child, and maternal morbidity and mortality [19]. Various studies showed that birth spacing is one of the risk factors for neonatal mortality [9], [10]. It was also found in this study, mother who gave birth before 2 years of previous birth was at risk for their infant to experience neonatal mortality 2.6 times compared to mother who gave birth more than 2 years. The maternal nutritional depletion hypothesis states that short birth spacing worsens the mother's nutritional status because of inadequate time to recover from the physiological stresses of the preceding pregnancy [20].

Birth weight and parity were not significantly associated with neonatal mortality. Birth weight was as confounding factor for gestational age and antenatal care. Infant born with low body weight is generally born not term. It was found that 52.4% of infant born with birth weight <2500 g and gestation age < 37 weeks compared to 15.7% of infant born <2500 and gestation age 37–42 weeks. The proportion of infants with birth weight < 2500 g who underwent antenatal examination < 4 times was 30.3% compared to birth weight < 2500 g and antenatal examination 4 times was 8.0%.

Parity was not significantly associated with neonatal mortality but as confounding factor for gestational age. Mothers that had parity ≥3 had odds ratio 2.9 (95% CI: 1.5–5.5) to gestational age < 37 weeks, with the result that mother had parity ≥ 3 had a greater risk to gestational age < 37 weeks.

Mother's education was not significantly as a risk factor of neonatal mortality in the present study. Other study found that mother's education was associated with neonatal mortality [10], some studies were not associated with neonatal mortality [7], [12]. The reason was possibility

due to the proportion of low and high education in the case and control groups which was almost similar.

The limitations of the study were that not all risk factors for neonatal mortality were available in the autopsy form of death or birth cohort data, such as consumption iron tablets or multi-micronutrient during pregnancy, maternal nutritional status, and illnesses suffered by the mother before pregnancy, weight gain, and disease occurring during pregnancy. Neonatal mortality data used are data recorded or reported by hospitals and community health centers, while data on deaths that were not recorded or reported cannot be known.

Conclusion

The antenatal care, gestational age, mother's age, and birth spacing are preventable or possibly preventable risk factors. As a recommendation, the Health Office of Pekanbaru and Community Health Service should increase promotion of antenatal care for pregnant women and family planning to preserve birth spacing for women of childbearing age. It is required of empowering cadres in an effort to detect early risk factors for neonatal mortality in the community. Filling out the death autopsy form and birth cohort data needs to be the concern of all parties.

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