Advances in Health Sciences Research, volume 25
2nd Sriwijaya International Conference of Public Health (SICPH 2019)

Low Birth Weight and Asphyxia Neonatorum Risk: A Case-Control Study

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Abstract— **Asphyxia neonatorum is the cause of 23% of all neonatal mortality in the world. Three quarters from the neonatal mortality are caused by conditions that can be prevented and treated, including the incident of asphyxia. Low Birth Weight (LBW) has the risk of having a respiratory failure that can cause asphyxia neonatorum. However not all LBW infants are prematurity. Therefore, it can be estimated that approximately one-third of LBW is aterm infants. This research was conducted in Budi Kemuliaan Hospitals, which one of the private mother centers and child hospital that reference the birth process in Jakarta. The design of this research was case-control by using medical record data, with 120 cases and 240 controls and data was collected from March to May 2018. The bivariate and multivariate data were analyzed using the chi-square test to see the association value after being controlled by covariate variables (sex of the baby, maternal age characteristics, gestational age, maternal parity, history of antenatal care (ANC), preeclampsia or eclampsia during pregnancy). The result of this study showed that asphyxia neonatorum on the LBW had risk with OR=2.17 (95% 0.88-5.37) and the risk increase with OR=4.69 (95% 2.68-8.18) on the premature infants. It is important to conduct selective monitoring of fetal conditions and early detection of asphyxia, especially in babies who have a high risk such as LBW and premature birth.**

Keywords: low birth weight, asphyxia, premature

I. INTRODUCTION

Child mortality is one important indicator of the degree of public health [1]. It is estimated that every day there are 830 women and 7,300 newborns die due to complications during pregnancy, childbirth and further neonatal causes. In addition, 7,000 women experience stillbirths and half of them occur after delivery. Three-quarters of all newborn mortality is caused by three conditions that can be prevented and treated, including complications, premature birth, intrapartum death (including asphyxia) and neonatal infection [2].

Every year around the world, it is estimated at 3.3 million stillbirths and as many as 3.7 million neonatal mortality. Of the total neonatal deaths, 38% of deaths occur in children under the age of five, three quarters in the first seven days of life are called early neonatal deaths [3] [4]. Neonatal deaths continue to receive attention and priority, especially in the health sector. According to the World Health Organization (WHO) there are three main causes of neonatal death worldwide, namely infection (36%, which includes sepsis / pneumonia, tetanus and diarrhea), pre-delivery (28%), and birth asphyxia (23%). There are several variations between countries depending on the configuration of their care [5].

In the United States and most other developed countries, the incidence of asphyxia is 1-4 cases per 1000 live births [6]. While in developing countries can reach 31% or more, in Indonesia it is estimated that the incidence of asphyxia is approximately 40/1000 live births. WHO reports Case Fatality Rate (CFR) for asphyxia neonatorum at 11% where the first minute 47/1000 live births and in the first five minutes 15.7/1000 live births.

The cause of (0-6 days) neonatal mortality in developing countries including Indonesia are asphyxia, prematurity, infection and hypothermia. Infection and hypothermia can be caused by low birth weight and premature birth. Therefore the role of LBW for infant mortality in the first week is quite significant [4]. Health problems that commonly occur in b abies with low birth weight (LBW) include disorders of the respiratory system, central nervous system, cardiovascular, hematological and kidney [7].

The causes of LBW infants in general are multifactorial, both from maternal factors, placental factors, and fetal factors as well as other factors [8]. LBW has a risk of death under the age of 1 year and the risk is 17 times greater than babies born with normal birth weight. This is possible because in LBW the maturity of body organs is not yet perfect [9].

Based on this description and bearing in mind that neonatal asphyxia is one of the causes of infant morbidity and mortality, it is essential to look at the risk factors associated with asphyxia especially those related to low birth weight (LBW).

II. METHOD

This study is an analytic study with a case control design that aims to determine the relationship of low birth

weight to the incidence of neonatal asphyxia. This research was conducted on March 1 to May 14, 2018 at RSIA Budi Kemuliaan Jakarta, the hospital is one of the referrals private maternal and child hospitals for the birth process in Jakarta.

The study population in this study were mothers who gave birth at the Budi Kemuliaan Hospital in Jakarta in 2017, which were 4372 births. Case inclusion criteria were mothers who gave birth to babies with asphyxia neonatorum in 2017 and a single pregnancy. The number of eligible mother is 120 cases, and all of them are taken as sample cases. While the case and control exclusion criteria are mothers who gave birth with a medical record not found or incomplete, mothers who have severe infections disease, give birth to be amused and have babies with congenital abnormalities.

The inclusion control criteria were mothers who gave birth to babies who were not asphyxia in 2017, the selection of the control group was made by unmatched control using a systematic random sampling method. To increase the power of the study, the number of controls in this study uses a ratio of 1: 2 with cases, namely the number of controls is twice the number of cases. Because the number of cases was 120, the number of controls was 240, bringing the total study sample to 360.

The research instrument used was an abstraction sheet for transferring medical record data. The data collected is data on the baby's weight at birth as the primary variable, which is categorized as normal (≥ 2500 grams) and LBW (<2500 grams). Meanwhile, covariate variable data includes the sex of the baby, maternal age characteristics, gestational age, maternal parity, history antenatal care (ANC), history of maternal preeclampsia or eclampsia during pregnancy.

Information on outcome variables, namely infant asphyxia was gained by seeing APGAR score and diagnosis of asphyxia by doctors in the medical records data processing. Then the data was analysed using Stata 13 statistical applications by conducting unconditional logistic regression to examine the association of low birth weight to neonatal asphyxia through the calculation of odds ratio and 95% confidence intervals. This research was assisted by two enumerators who had been blinded to the research hypothesis to avoid bias.

III. RESULTS

The results of bivariate analysis of the relationship between the main dependent variables on independence can be seen in Table 1 below.

Table I. Bivariate Analysis of Low Birth Weight and Covariate Variables Risk with Asphyxia Neonatorum at Budi Kemuliaan Hospital in 2017

Variables	Categorized	Case	Control	OR (95% CI)*
Birth Weight	Normal	64 (53.3%)	192 (80.0%)	Ref
	LBW	9 (7.5%)	15 (6.3%)	1.80 (0.75-4.31)
	Premature	47 (39.2%)	33 (13.8%)	4.27 (2.52-7.24)
Age of Mother	<20	6 (5.0%)	2 (0.7%)	6.80(1.34-34.38)
	20-35	86 (71.7%)	195 (81.3%)	Ref
	>35	28 (23.3%)	43 (17.8%)	1.47(0.86-2.53)
Parity	Multipara	76 (63.3%)	142 (59.2%)	Ref
	Primipara	44 (36.7%)	98 (40.8%)	1.19(0.75-1.87)
ANC	≥ 4	100 (83.3%)	189 (78.8%)	Ref
	< 4	20 (16.7%)	51 (21.3%)	1.34(0.76-2.38)
Preeklampsia/ Eklampsia	No	3 (2.5%)	1 (0.4%)	Ref
	Yes	117 (97.5%)	239 (99.6%)	6.12(0.63-59.55)
Gestational Age	< 37 weeks	75 (62.5%)	207 (86.25%)	Ref
	≥ 37 weeks	45 (37.5%)	33 (13.75%)	3.76(2.23-6.33)
Sex of baby	Female	52 (43.3%)	128 (53.3%)	Ref
	Male	68 (56.7%)	112 (46.7%)	1.49(0.961-2.323)

*Odds Ratio (OR) (95% confidence interval (CI)) unadjusted
Ref: reference

Based on Tabel I, test results show that the relationship of asphyxia with LBW enough to assess the OR value of 1.80 (0.75-4.31) with a p-value of 0.187, which means not significant. Whereas the relationship of asphyxia with premature OR exchange rate is 4.27 (2.52-7.24) with a p-value of 0.000, which means there is a significant relationship in other words babies born prematurely (normal and LBW), who are born with normal weight and enough months.

The distribution of table 1 above shows that in the case group, 5.0% of mothers aged <20 years and higher were 71.7% of mothers aged 20-35 years and 23.3% of those aged> 35 years. Whereas in the control group, mothers giving birth to asphyxia were 6.80% of mothers aged <20 years higher than mothers aged 20-35 of 1.0%. In the parity variable, in the case group 63.3% of multipara mothers and 36.7% of primiparous mothers gave birth to asphyxia babies. In the control group, 59.2% of multiparous mothers and 40.8% of primiparous mothers gave birth to asphyxia infants.

Regarding the providing antenatal care (ANC) when pregnant women, it can be seen that mothers who gave birth to asphyxia infants 16.7% who did not have antenatal care (ANC) routinely during pregnancy and 83.3% checked regular. Whereas in mothers who gave birth to babies who were not asphyxia by 21.3% did not have antenatal care (ANC) routinely during pregnancy and 78.8% were routinely examined.

In the gestational age variable in the case group, it can be seen that 62.5% are born at term and 37.5% are term. Whereas in the control group 86.35% were born at term and 13.75% were term. Gender Based on the results of a bivariate analysis of the sex of the baby, it can be seen that the percentage of babies with asphyxia is higher in the male sex (56.7%) while in women as much as 43.3%. In infants who are not asphyxia, female presentation is 53.3% higher than males 46.7%. From the results of statistical tests it was found that baby sex with the incidence of asphyxia did not have a significant relationship with p-value> 0.05 and OR 1.49 (95% CI 0.96-2.32).

Table 2. Multivariate Logistic model association between Low Birth Weight and Asphyxia Neonatorum at Budi Kemuliaan Hospital in 2017

Variables	Categorized	OR Crude OR (95% CI)	OR Adjusted OR(95% CI)	p-value
Birth Weight	Normal	1.00 Ref	1.00 Ref	-
	LBW	1.80 (0.75-4.31)	2. 17 (0.88-5.37)	0.000
	Premature	4.27 (2.52-7.24)	4.69 (2.68-8.18)	
Age of Mother	<20	6.80 (1.34-34.38)	4.36 (0.71-26.50)	0.109
	20-35	1.00 Ref	1.00 Ref	-
	>35	1.47 (0.86-2.53)	1.68 (0.95-2.98)	0.072
Sex (infants)	Female	1.00 Ref	1.00 Ref	-
	Male	1.49 (0.96-2.32)	1.79 (1.11-2.90)	0.016
Preeklampsia/ Eklampsia	No	1.00 Ref	1.00 Ref	-
	Yes	1.79 (1.04-3.09)	2.00 (1.10-3.64)	0.022

#Sig < 0.05
Ref: reference

Multivariate analysis in Table II, above shows the results that low birth weight is associated with neonatal asphyxia. The final model shows that there are differences or changes in OR values before and after multivariate analysis. OR crude before calculating other risk factors was obtained at 1.80 (0.75-4.31) for the risk of neonatal asphyxia and a higher risk in premature infants of 4.27 (2,252-7.24). However, after controlling for other risk factors that also have influence (maternal age, sex of the baby, preeclampsia/eclampsia), on the relationship of low birth weight with neonatal asphyxia, obtained an OR value of 2.17 (0.88-5.37). That means that the risk of asphyxia in infants born with low birth weight is 3.32 times higher than babies born with normal weight. The risk is increased by 4.69 (2.68-8.18) for suffering from asphyxia.

IV. Discussion

Asphyxia neonatorum is a failure to breathe spontaneously and regularly immediately after birth [10]. Total of births was 4750 and asphyxia cases was 148 babies (3.12%) in 2017 at Budi Kemuliaan Hospital. According to WHO report, every year around the world the is 3% (3.6 million) of the 120 million babies born having asphyxia, almost one million babies was die.

The results of this study support the results of previous studies related to low birth weight increase morbidity and infant mortality. Infant birth weight determines the prognosis and complications that occur including the risk of asphyxia. The results of this study found that low birth weight is at risk for neonatal asphyxia. In recent decades, attention to low birth weight (LBW) babies has dramatically increased. Previous epidemiological studies have found that babies with LBW experience imperfect lung growth and development, coughing reflexes, sucking and swallowing reflexes, which are poorly coordinated, and assisting muscles weak breathing. This causes difficulty in breathing and can result in asphyxia [11] [12].

Other results with a hospital medical record-based case control study, show that LBW infants are at risk of developing neonatal asphyxia compared to babies of normal birth weight (OR = 3.32; 95% CI 1.71-6.44). The results of research at the Tehran Hospital, Iran with a case-control design of 546 infants, found that low birth weight (<2500 grams) was a risk factor for asphyxiation, where infants with LBW 3.13 times (95% CI 1.23-7.99) to experience neonatal asphyxia compared babies of normal weight [13].

In LBW the risk of experiencing respiratory failure becomes neonatal asphyxia, due to the lack of surfactant based on the ratio of lecithin less than 2. Besides the growth and development of imperfect lungs, respiratory muscles are still weak and the ribs are easily curved (pliable thorax) with the baby's condition will be at risk of hypoxia [14]. Based on low birth weight (<2500), the results of this study are in line with research conducted in Pakistan that looked at risk factors for asphyxia in 240 neonates, where LBW infants who experienced asphyxia were (20.3%). Whereas based on gestational age, preterm babies with asphyxia were quite high (43.9%) [15].

A study in Ethiopia with a case control method and the case determination based on APGAR scores with a total sample of so many found that low birth weight was a significant factor in increasing asphyxia births [16]. LBW has the risk of experiencing respiratory failure that can cause neonatal asphyxia. This condition occurs due to a lack of lung surfactant, lung growth and development that is not yet perfect, respiratory muscles are still weak and the ribs are easily curved. The results of the study at Karanganyar District Hospital concluded that there was a significant relationship between the LBW degree and the severity of neonatal asphyxia, the heavier the LBW level, the higher the severity of the neonatal asphyxia (11).

The results of this study show that there is a significant association between the birth weight of babies with the incidence of asphyxia, the highest risk can be seen in babies born prematurely, whether they are of normal weight or LBW. Premature babies (gestational age <37 weeks) need special preparation. His organs are not mature yet, and this causes the respiratory system, especially the baby's lungs, not work optimally. Moreover, the surfactant is still lacking so there is a possibility of lung development problems also, respiratory muscles are still weak so that premature baby crying sounds weak and can cause the baby to experience asphyxia [17].

V. Conclusion

The result of this study population conclude that there are association of asphyxia neonatorum and low birth weight at RSIA Budi Kemuliaan Jakarta in 2017. LBW infants is a risk for asphyxia compared to normal weight infants, and the risk increase for prematurity to asphyxia neonatorum. Based on the result, it is important to conduct

selective monitoring of fetal condition and early detection of asphyxia, especially in babies who are at risk such as LBW and premature birth.

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