Path Analysis on the Determinants of Neonatal Asphyxia at Dr. Saiful Anwar Hospital, Malang

Dewy Indah Lestary[1], Endang Sutisna Sulaeman[2], Nunuk Suryani[3]

[1]Academy of Midwifery Wijaya Kusuma, Malang, East Java
[2] Faculty of Medicine, Universitas Sebelas Maret
[3]Faculty of Teaching and Educational Sciences, Universitas Sebelas Maret

ABSTRACT

Background: Neonatal asphyxia is one of the main causes of neonatal mortality. Many factors may have caused neonatal mortality. This study aimed to investigate the determinants of neonatal asphyxia at Dr. Saiful Anwar Hospital, Malang.

Subjects and Method: This was an observational analytic study with case control design. The study was conducted at Dr.Saiful Anwar, Malang, East Java, in June 2016. A total of 53 newborn babies with asphyxia (cases) and 159 newborn babies without asphyxia (controls) were selected by fixed disease sampling for this study. There were three exogenous variables: prematurity, maternal age, and parity. The endogenous variables were birthweight and neonatal asphyxia. The data were collected by a checklist. The data were analyzed by path analysis model.

Results: Low birthweight had positive direct effect on the risk of neonatal asphyxia (b=1.61; 95% CI= 0.86 to 2.37; p<0.001). Prematurity (b=0.93; 95% CI= 0.13 to 1.74; p<0.023), maternal ages <20 or ≥35 years (b=0.97; 95%CI = 0.05 to 1.87; p<0.034), and parity primipara or ≥4 parity (b=1.00; 95% CI = 0.155 to 1.85; p<0.021), had positive indirect effects on the risk of neonatal asphyxia via Low birthweight.

Conclusion: Low birthweight had positive direct effect on the risk of neonatal asphyxia. Prematurity, maternal ages <20 years or ≥35 years, and parity primipara or ≥4 parity, had positive indirect effects on the risk of neonatal asphyxia via Low birthweight.

Keywords: neonatal asphyxia, low birth weight, prematurity, maternal age, parity.

Correspondence:
Dewy Indah Lestary. Academy of Midwifery Wijaya Kusuma, Malang, East Java. Email: dewylestary86@gmail.com

BACKGROUND

Millenium Development Goals (MDGs) targets the infant mortality rate to be around 32/1,000 parities in 2015. In 2011, the neonatal mortality rate in ASEAN countries, including Indonesia, reached 31 per 1,000 live birth. This rate was 5.00 times higher than that in Malaysia, 1.20 times higher than that in Phillipine, and 2.40 times higher than that in Thailand.

The Survey of Indonesian Demography and Health 2017 has estimated that the Neonatal Mortality Rate in Indonesia from 2003 until 2007 is around 34 per 1,000 live birth (Depkes RI, 2008). In Indonesia, 57.00% of the overall infant mortality rate occurs during the neonatal period (under 1 month old). Every 6 minutes one case of neonatal mortality occurs (JNPK-KR, 2008).

Neonatal asphyxia is one of the causes behind the neonatal mortality. According to World Health Organization, in every year around 3.00% (3.60 million) of 120 million newly born infants have asphyxia and around 1 million of these infants die because of it. The causes of neonatal mortality are Low birthweight (29.00%), asphyxia (27.00%), labour trauma, neonatal tetanus,

and other infection or congenital disorders (Wiknjosastro, 2010).

Neonatal asphyxia refers to the condition in which an infant is unable to breathe so that the O_2 rate decreases and the CO_2 rate increases; this situation leads to poor condition in further life period (Manuaba, 2010). Asphyxia means progressive hypoxia, CO_2 containment, and acidosis. If the process continues further, then brain damage or even mortality will occur. Asphyxia may also influence the function of other vital organs (Prawirohardjo, 2009).

The factor that causes the occurrence of asphyxia lies on the mother, namely the mother's age that is younger than 20 years old or older than 35 years old (DepKes RI, 2009). Pregnancy on the overly young age and overly old age belongs to the criteria of high-risk pregnancy and the two kinds of pregnancy contributes to increasing both the morbidity and the mortality to the mother and the fetus (Widiprianita, 2010).

Pregnancy at overly young age (<20 years old) belongs to the high-risk pregnancy because the mother is not prepared medically (referring to the reproduction organs) and mentally. The results of several studies show that primiparity is a risk factor that has strong relationship to the asphyxia mortality. On the other hand, pregnancy at overly old age (≥35 years old) causes the mother to suffer from physical drawback during the pregnancy period. This situation is a predisposition for the occurrence of haemorrhage, placenta previa, uterine rupture, and solutio placentae which may result in the neonatal asphyxia (Purnamaningrum, 2010).

Premature infant (<37 weeks) has higher risk to experience mortality due to asphyxia (Lee, 2006). In general, disorders have started since the pregnancy and the examples of these disorders are fetal distress or fetal compromise during the

labor. Premature infant prior to 37 weeks of pregnancy is one of the risks that lie behind the occurrence of neonatal asphyxia. There is a strong relationship between pre-term labor that causes the incomplete formation of organ functions in the infant and the respiratory failure within the premature infant and surfactant deficiency within the infant's lungs (Purnamaningrum, 2010).

According to Aminulloh (2002) in Katriningsih (2009), the occurrence of asphyxia can be seen from the factor on the mother, such as the mother's age during the pregnancy, the mother's age during the labor, and the parity, and also from the factor on the infant such as prematurity.

Based on the results of a study by Revrely in IRINA D Room of RSUP Prof. Dr. R. D. Kandou Central Public Hospital Manado, the relationship between the mother's age that shows the highest percentage of neonatal asphyxia case is the age of high-risk pregnancy (<20 years old; ≥35 years old) with 13 infants experience asphyxia (52.00%). The results of analysis toward the relationship between the two variables using Chi Square statistic test shows that there is a relationship between the mother's age and the asphyxia incidence with p= 0015 and OR= 1.56. This relationship implies that babies of the mothers with high-risk pregnancy age (<20 years old or ≥35 years old) have 1.56 times chance to suffer from neonatal asphyxia in comparison to the babies of the mothers without high-risk pregnancy age (20-35 years old) (Revrely, 2013).

The high Infant Mortality Rate is caused by neonatal asphyxia (49-60%), infection (24-34%), Low birthweight (15-20%), labor trauma (2-7%), and congenital defects (1-3%) (Aprilia and Ramadhan, 2012). A study by Aprilia and Ramadhani (2012) showed that from 32 pregnant mothers who experienced prolonged

labour, 24 babies (75.00%) suffered from asphyxia while from 55 mothers who did not experience obstructed labour, 29 babies (52.70%) did not suffer from asphyxia.

The Infant Mortality Rate in the Province of East Java in 2012 was 29.24 per 1,000 live birth; this figure decreases form the previous year namely 29.99 per 1,000 live birth; however, this rate is still under the MDG target in 2015 namely 23.00 per 1,000 live birth. Several causes of infant mortality in the Province of East Java are Low birthweight (38.30%), asphyxia (26.75%), neonatal tetanus (0.39%), infection (4.99%), labour trauma (1.47%), and other congenital defects (12.61%) including hyperbilirubinemia (15.49%). In the City of Malang, it is recorded that the Annual Infant Mortality Rate claims 509 lives due to asphyxia (60.00%), Low birthweight (30.00%), and tetanus (10.00%).

Parity 1 belongs to the high-risk pregnancy because the mother is not prepared both medically (in terms of reproduction organ) and mentally. The results of several studies show that primiparity is a risk factor that has strong relationship to the asphyxia mortality. On the other hand, Parity 4 and above show that the mother experiences physical drawback during her pregnancy. This situation provides a disposition to the occurrence of haemorrhage, placenta previa, uterine rupture, and solutio placentae that might lead to the occurrence of neonatal asphyxia (Purnamaningrum, 2010).

According to the results of a study by Katriningsih (2009) entitled The Relationship between the Maternal Factors and the Neonatal Asphyxia Incidence in Pandan Arang Public Hospital using the Chi Square statistical test, it was found that there was a meaningful relationship between the parity and the neonatal asphyxia with p = 0.004.

Based on the data that the researchers attain from the Midwifery Medical Record of Saiful Anwar Regional Public Hospital Malang, in 2012 the number of births was 2,437 babies and the number of neonatal asphyxia was 105 incidences (4.30%). In 2013 the number of births was 2,183 babies and the neonatal asphyxia rate is 143 cases (6.20%). In 2014 the number of births was 2,410 babies and the number of neonatal asphyxia incidences was 167 cases (6.90%). The data of the last three years shows the percentage of asphyxia incidences is increasing from the previous years (RSUD Dr. Saiful Anwar Malang, 2014).

Based on the above background, the researchers were interested in conducting a study to identify the determinants of neonatal asphyxia in Dr. Saiful Anwar Regional Public Hospital Maang.

SUBJECTS AND METHOD

The study was an analytical observational using case control approach. The study was conducted in Dr. Saiful Anwar Regional Public Hospital Malang in the Province of East Java. The subjects in this study were 106 infants who were selected using fixed disease sampling with ratio 1:2 between the case group and the control group. The independent variables were prematurity, maternal age, parity, and Low birthweight. The dependent variable was neonatal asphyxia incidence. The bivariate data analysis made use of Chi Square, while the multivariate data analysis made use of path analysis.

RESULTS

The characteristics of of the subjects in the study were occupation, education, marital status, and number of ANC visit. 93 subjects (58.50%) were unemployed. Most of the subjects were graduates of senior high

school or higher institution (62.30%). All of the subjects were married and most of them

conducted ANC visit at least four times or more (54.10%).

Table 1. The results of chi square analysis toward the determinants of neonatal asphyxia

Independent Variables	Dependent Variables	OR	p
Low Birtweight	Asphyxia	5.02	5.022
Parity	Prematurity	2.73	0.016
Mother's Age	Prematurity	2.65	0.029
Prematurity	Low birthweight	2.54	0.021

The data analysis was performed using the path analysis with the assistance of Stata 13. The preliminary model in the path analysis went through the bivariate analysis stage in order to identify the relationship among the variables by using the chi-square

Low birthweight influenced the incidence of asphyxia and the influence was statistically significant. The infant that was born with Low birthweight would have 5.02 times higher risk to experience asphyxia in comparison to the infant that was born with normal birthweight (OR = 5.02; p = 5.022).

Mothers with parity 1 or ≥4 would have 2.73 times higher risk to give birth to premature infant in the labor in comparison to the mothers with parity 2 or 3 (OR = 2.73; p= 0.016). The mothers whose age that was < 20 years old or ≥ 35 years old would have 2.65 times higher risk to give birth to premature infant in comparison to the mothers whose age between 20 and 35 years old. The premature infants would have 2.54 times higher risk to experience Low birthweight in comparison to the normal infants.

Table 2. The results of path analysis toward the determinants of neonatal asphyxia

| Independent Variable		Dependent Variable	b	CI 95.00%		p
				Lower Limit	Upper Limit	
Direct effect						
Asphyxia	←	Low birthweight	1.61	0.86	2.37	<0.001
Indirect						
Low birthweight	←	Prematurity	0.93	0.13	1.74	0.023
Prematurity	←	Mother's Age (<20 or ≥35 years old)	0.97	0.05	1.87	0.034
Prematurity	←	Parity (1 or ≥ 4)	1.00	0.155	1.85	0.021
n observation	=	159				
2Log likelihood	=	-257.81				
AIC	=	529.62				
BIC	=	551.11				

Mother's age influenced the incidence of prematurity and the effect was statistically significant. The mothers whose age was < 20 or ≥35 years old had 2.64 greater risk in comparison to the mothers whose

age was between 20 and 35 years old. The premature infants influenced the occurrence of low birthweight and the influence was statistically significant. The premature infants would have 2.541 higher risk than

the normal infants with aterm (OR = 2.541; p = 0.021).

Table 2 showed that there was positive and statistically significant relationship between the occurrence of low birthweight and the occurrence of neonatal asphyxia on the infants with low birthweight and that the infants with low birthweight had 1.61 points higher on the logodd asphyxia score in comparison to the infants with normal birthweight. There was also positive and statistically significant relationship between the premature infants and the occurrence of neonatal asphyxia and the premature infants had 0.93 units higher on the logodd asphyxia score in comparison to the normal infants.
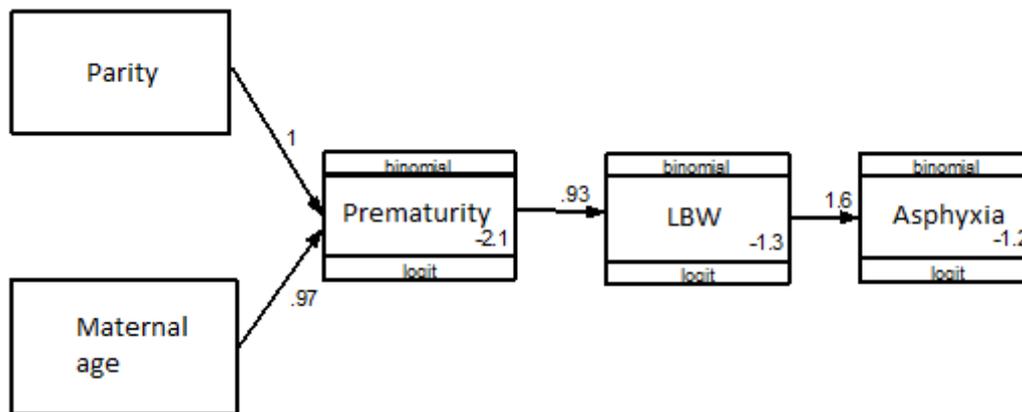
Figure 1. Path Analysis Model with Estimation

DISCUSSION

The results of analysis on the influence of low birthweight occurrence toward the neonatal asphyxia showed that there was positive and statistically significant relationship between the low birthweight occurrence and the neonatal asphyxia to the infant with 1.61 points higher logodd asphyxia score in comparison to the normal infant.

Respiratory disorder often results in severe diseases on the infants with low birthweight. The disorder is caused by the lack of surfactant and the incomplete growth and development of the lungs. The respiratory muscle is still weak and the ribs are flexible; as a result, the infants often experience apnea, acute asphyxia, and respiratory distress syndrome. This situation occurs because the mothers have insufficient education and the insufficient education leads to the low number of pregnancy examination. Due to that, the fetus cannot be well maintained.

Low birtweight refers to the condition of the infants that are born with 2,500 g without considering the pregnancy period. Airway refers to the pathway that channels the air through nose, pharynx, trachea, onchioles, bronchioles respiratorius, and ductus to the alveoli. Obstruction on the airway might result in asphyxia, hypoxia, and finally death. In addition, infants with low birthweight cannot adapt themselves to the asphyxia that occurs during the labor process so that these infants might be delivered with perinatal asphyxia. The infants with low birthweight are prone to the attacks of apnea and respiratory distress syndrome and as a consequence these infants do not attain sufficient amount of oxygen which they used to attain from placenta (Proverawati, 2010).

A study by Ketut (2014) found the factors that related the low birthweight to the neonatal asphyxia (OR= 3.39; 95% CI= 1.07 to 10.69). Based on the result of that

study, the researchers might conclude that there is direct influence from the low birth-weight occurrence to the neonatal asphyxia occurrence.

1. The effect of premature birth and neonatal asphyxia

The results of analysis showed that there was positive and statistically significant influence from the premature infant to the occurrence of neonatal asphyxia and the premature infants had 0.93 point higher logodd asphyxia score in comparison to the aterm infants.

A study by Ketut (2014) in Denpasar, Indonesia, found that there is influence from the prematurity to the occurrence of neonatal asphyxia. Statistically, prematurity has significant influence on the neonatal asphyxia ($p < 0.001$).

Premature infants tend to experience Low birthweight and and are prone to the attack of apnea and respiratory distress syndrome. Consequently, these infants do not attain sufficient amount oxygen like they used to have from their placenta and they have the risk of experiencing the neonatal asphyxia.

2. The efefct of maternal age and neonatal asphyxia

There was positive and statistically significant influence from the parity 1 or parity ≥ 4 and the occurrence of the neonatal asphyxia to the infants of the mothers whose age was average with 0.97 point higher logodd asphyxia score in comparison to the infants of the mothers whose age was between 20 and 35 years old.

Based on the results of a study by Revrely in IRINA D Room of Prof. Dr. R.D. Kandou Central Public Hospital, the relationship between the mother's age and the neonatal asphyxia that shows the highest percentage is the mothers whose age is risky (<20 years old or ≥ 35 years old) with asphyxia-experiencing infants (13 infants or

52.00%). From the analysis of results between the two variables using Chi-Square Statistical Test, there is a relationship between the mother's age and the occurrence of asphyxia neonatal with $p = 0.015$ and OR = 1.563. The statement implies that the mothers whose age is risky (<20 years old or ≥35 years old) have 1.563 times opportunity to deliver the infants with asphyxia in comparison to mothers whose age is not risky (20-35 years old).

A study by Kusparlina (2016) shows a relationship between the mother's age and the mother's nutrition status based on the upper arm circumference size to the Low birthweight type. The mothers who are pregnant and deliver the infants in the risky age and also experience chronic energy shorate tend to deliver the infants with low birthweight. From the study that were conducted, it is expected that the health workers promote the health of the mothers more by performing early detection using ANC examination with 7T standards. From the results of Fisher Exact test, the researchers found $p = 0.011$ for age and $p = 0.024$ for upper arm circumference size.

Based on the results, the researcher might conclude that there is indirect influence from the mother's age to the occurrence of neonatal asphyxia. Thus, the results of this study might be considered in line with the above studies.

3. The influence of parity to the occurrence of neonatal asphyxia

There was positive and statistically significant influence from the parity 1 or ≥4 and the occurrence of neonatal asphyxia to the infants with average parity that had 1.00 point higher logodd asphyxia score in comparison to the parity.

According to the results of a study by Katriningsih (2012) that investigated the relationship between the factors of infant number and the occurrence of neonatal

asphyxia in the Pandan Arang Central Public Hospital using Chi Square Statistical Test, there is a meaningful relationship between the parity and the neonatal asphyxia with p = 0.004.

Parity 1 is risky because the mothers are not medically (in terms of reproduction organs) and mentally prepared. The results of the study showed that primiparity and multiparity might be influenced by the factors of mother's education. The mother's low education might result in the insufficient knowledge regarding the danger, the complication and the factors of nutrition and this will cause the mothers to experience anemia during the pregnancy. This situation itself might be a factor of risk that has strong relationship to the death due to asphyxia. On the other hand, in parity above 4 the mothers experience physical drawback in experiencing pregnancy. Such situation contributes to the predisposition for the occurrence of haemorrhage, placenta previa, uterine rupture, and prematurity solutio placenta. All of these matters will result in low birthweight that might cause neonatal asphyxia (Purnamaningrum, 2010).

Based on these results, the researchers might conclude that there is indirect influence from the parity to the occurrence of neonatal asphyxia. Thereby, the results of this study are concurrent to the previous studies.

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