



The Main Casual Factors Associated with The Incidence of Asphyxia Neonatorum

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ABSTRACT

Background: Asphyxia is the second most common cause of neonatal death after babies with low birth weight (LBW). The factors that can cause asphyxia include preeclampsia, premature birth, prenatal anemia, antepartum bleeding and premature rupture of membranes.

Purpose: This study aimed to determine the main causative factors associated with the incidence of asphyxia neonatorum at RSUP Dr. M. Djamil Padang in 2021.

Methods: This research was a quantitative research with an analytic approach with a cross sectional design, was conducted in the Medical Record Sub-Division of RSUP Dr. M. Djamil Padang in December 2022. The sample in this study were babies who were diagnosed with asphyxia totaling 132 people obtained by total sampling technique. Collection data were taken from patient medical records and analyzed univariately, bivariately (test chi square), and multivariate (logistic regression analysis) with 95% CI.

Results: The result showed that 77.3% of patients had moderate asphyxia. The result of this study showed that majority of patients with severe asphyxia with preeclampsia mothers 60.0% ($p=0.001$), premature birth 76,7% ($p=0.044$), anemia mothers 53,3% ($p=0.035$), did not experience antepartum hemorrhage 83,3% ($p=0.390$), and premature rupture of membranes 73,3% ($p=0.000$). The most dominant factor was premature rupture of membranes with $OR=34.988$.

Conclusion: It was concluded that there was a relationship between preeclampsia, premature birth, prenatal anemia, premature rupture of membranes, and there was no relationship between antepartum bleeding and neonatal asphyxia. The factor that has the most dominant influence on the incidence of neonatal asphyxia is premature rupture of membranes. Suggestions for health workers to maintain and improve services to patients, especially asphyxia neonatorum.

Keywords: *Asphyxia; Preeclampsia; Premature Birth; Anemia in Mother; Premature Rupture of Membrane*

BACKGROUND

The degree of public health can be determined by looking at the high and low infant mortality rate (IMR), which is a reflection of the level of health development in a country and the quality of life of the community. Of all infant deaths, it often occurs in the neonatal period. Infants under one month of age are the age group that has the highest risk of health problems and various health problems can arise, so that without proper treatment, they can be fatal. Based on data from the, (WHO, 2016) neonatal deaths reached 2.6 million. Data from the United Nations Children's Fund (UNICEF) shows that the global average of neonatal deaths has reached 18 deaths per 1,000 live births in 2018 (Bohren et al., 2019).

In 2019, the second most common cause of neonatal death is asphyxia after low birth weight (LBW) (Abdo et al., 2019). Data shows that 4-9 million newborns experience asphyxia each year. The average incidence of neonatal asphyxia in developing countries is higher than in developed countries, ranging from 4.6-20 per 1000 births (WHO, 2016). Based on the 2019 Indonesia Health Profile data, the cause of neonatal death in Indonesia is due to asphyxia of 27.4%. In West Sumatra Province, based on data from the Indonesian Ministry of Health, in 2020 there were 151 cases of neonatal death due to asphyxia and West Sumatra ranked third within the scope of the island of Sumatra after Aceh with 278 cases and North Sumatra with 178 cases. In the city of Padang the number of asphyxia incidents in 2019 was reported as many as 21 cases and in 2020 as many as 11 cases (Anisa et al., 2017). Based on the initial survey that was conducted at RSUP Dr. M. Djamil Padang obtained data on babies who experienced asphyxia in 2020 as many as 98 babies. Whereas in 2021 it will increase compared to 2020, namely 139 babies.

Neonatal asphyxia can occur in conditions where newborns cannot breathe spontaneously and regularly due to lack of oxygen which is characterized by hypoxia, hypercarbia and acidosis (Portiarabella et al., 2021). Complications from asphyxia can lead to potentially fatal conditions such as hypoxic-ischemic encephalopathy, brain injury, autism, attention deficit hyperactivity disorder, seizures, and cerebral palsy. Meanwhile, babies who survive often face lifelong health problems (80%), such as disabilities, developmental delays, paralysis, intellectual disabilities, and behavioral problems (Abdo et al., 2019).

The factors that cause neonatal asphyxia are antepartum factors, intrapartum factors and fetal factors. Antepartum risk factors such as preeclampsia, oligohydramnios, antepartum bleeding, less than 4 antenatal care (ANC) visits, maternal age <20 years or >35 years, and low educational status. Intrapartum risk factors include breech presentation, prolonged second stage of labor, obstructed labor, and meconium aspiration syndrome. While the risk factors for the fetus include low birth weight, premature birth, multiple pregnancy, umbilical cord entanglement, resuscitation and fetal distress (Portiarabella et al., 2021).

Preeclampsia is a factor that influences neonatal asphyxia which is thought to be related to blood vessel constriction which causes a decrease in blood gas exchange and nutrients (World Health Organization, 2018). Some mothers who experience preeclampsia give birth to babies with asphyxia because blood flow to the placenta results in impaired function of the placenta, this condition triggers vasoconstriction of blood vessels to the placenta to decrease, this causes hypoxia in the fetus. A further consequence of hypoxia in the fetus is impaired gas exchange between oxygen and carbon dioxide resulting in neonatal asphyxia (Miyaoka et al., 2005).

Babies born prematurely are at risk of experiencing respiratory problems. The baby's lungs are not fully mature and the respiratory muscles are not working properly.

In addition, newborns with a gestational age of less than 37 weeks do not have sufficient surfactant and are at risk of experiencing neonatal asphyxia because surfactant plays a role in maintaining alveoli stability (Dimkpa & Oji, 2010).

Prenatal anemia is also a factor that is significantly associated with the incidence of neonatal asphyxia. Anemia in pregnant women occurs if the mother's Hb level in the third trimester, which was last measured before delivery, was <11 gr/dl. The results of research conducted by (Ratna Ningsih, 2019) show a significant relationship between anemia and neonatal asphyxia, where anemia in pregnancy causes obstacles to the formation of hemoglobin, so that the amount of hemoglobin cannot keep up with the increase in blood plasma volume. Anemia in pregnancy causes the transport of oxygen to the fetus to be disrupted. Disorders can cause hypoxia in the fetus in the womb so that at the time of birth it can cause asphyxia (Tasaw et al., 2018).

Antepartum hemorrhage is another risk factor for asphyxia. In Tasaw's study, et al (2018) stated that mothers with antepartum hemorrhage had a 12 times greater risk of giving birth to babies with asphyxia compared to mothers who did not experience antepartum bleeding. Antepartum bleeding may cause asphyxia because antepartum bleeding causes a decrease in blood flow from the mother to the placenta so that the baby experiences hypoxemia (Tasaw et al., 2018; Tunggal et al., 2022).

Premature rupture of membranes (PROM) is the rupture of the membranes before delivery, that is, if the opening in primiparas is <3 cm and in multiparas <5 cm. KPD will be at risk of causing infection in the mother which will have a high impact on increasing age, decreasing function and condition of the uterus such as the fertility rate of uterine tissue is reduced for the process of embryogenesis, the formation of amniotic membranes becomes thin and results in rupture of the membranes before there are signs of labor so that the volume of amniotic fluid decreases during labour. The insufficient volume of amniotic fluid can cause compression of the umbilical cord resulting in decreased O₂ levels for the fetus and increased CO₂ levels, stimulation of the vagus nerve occurs which causes slowing of fetal heart sounds and allows for asphyxia (Martini, 2021).

Based on the description above, the authors are interested in further researching the main causative factors associated with the incidence of neonatal asphyxia at Dr. M. Djamil Padang in 2021.

OBJECTIVE

The purpose of this study was to determine the main causative factors associated with the incidence of neonatal asphyxia at Dr. M. Djamil Padang in 2021.

METHODS

This type of research is a quantitative study with a cross sectional design. The research was conducted in the Medical Records sub-section of RSUP Dr. M. Djamil Padang. The sample in this study were all newborns who experienced neonatal asphyxia at Dr. M. Djamil Padang in 2021 as many as 132 babies taking into account the inclusion criteria. Sample collection in this study using total sampling technique.

The dependent variable in the study was neonatal asphyxia and the independent variables were preeclampsia, premature birth, prenatal anemia, antepartum haemorrhage, and premature rupture of membranes. The research instrument used was secondary data, namely newborn medical record data which contained variables to be studied at Dr. M. Djamil Padang in 2021 is in the form of a checklist sheet consisting of several columns, namely name, medical record number, mother's age, baby's age, gender, birth weight, APGAR score, preeclampsia, premature birth, prenatal anemia, antepartum bleeding, and

premature rupture of membranes. Then fill in according to the data that has been collected.

Data were analyzed by univariate analysis and bivariate analysis using chi-square test to obtain the relationship between the two variables and multivariate analysis using logistic regression test to determine the independent variable that has the most dominant effect on the dependent variable with a 95% CI.

RESULTS

Based on research that has been done in the medical records section of RSUP Dr. M. Djamil Padang in December 2022, the samples in this study were neonatorum asphyxia babies at Dr. M. Djamil Padang in 2021 as many as 132 patients.

Mother Characteristics

The characteristics of mothers who have asphyxia babies in this study can be seen in the following table:

Table 1. Mother Characteristics

Mother characteristics	f (n=132)	%
Maternal Age		
<20 or >35	34	25,8
20-35	98	74,2
Parity		
Primipara dan Grandemultipara	62	47,0
Multipara	70	53,0
Gestational Age		
<37	78	59,1
>= 37	54	40,9

Based on the table above, it shows that out of 132 asphyxic babies whose mothers were in the age range of 20-35 years (74.2%) with multiparous parity (53.0%) and gestational age <37 weeks (59.1%).

Univariate Analysis

Table 2. Frequency Distribution of Asphyxia Neonatorum Classification at Dr. M. Djamil Padang Year 2021

Neonatal Asphyxia	f	%
Severe Asphyxia	30	22,7
Moderate Asphyxia	102	77,3
Amount	132	100,0

Based on the table above, it can be seen that out of 132 babies, the majority of newborns had moderate asphyxia, 102 people (77.3%) and severe asphyxia, 30 people (22.7%).

Table 3. Frequency Distribution of Preeclampsia, Premature Birth, Anemia in Mothers, Antepartum Bleeding, and Premature Rupture of the Membranes at Dr. M. Djamil Padang Year 2021

Dependent Variable	Severe Asphyxia		Moderate Asphyxia	
	f (n=30)	%	f (n=102)	%
Preeclampsia				
1. Preeclampsia	18	60,0	27	26,5
2. Not preeclampsia	12	40,0	75	73,5
Premature birth				
1. Premature birth	23	76,7	55	53,9
2. Normal	7	23,3	47	46,1
Anemia in Mothers				
1. Anemia	16	53,3	77	75,5
2. Not anemic	14	46,7	25	24,5
Antepartum Bleeding				
1. Yes	5	16,7	27	26,5
2. No	25	83,3	75	73,5
Premature rupture of membranes				
1. Yes	22	73,3	26	25,5
2. No	8	26,7	76	74,5

Based on table 3, it shows that out of 30 babies who experience asphyxia severe, most of the mothers had preeclampsia as many as 18 people (60.0%), came from of premature births, namely 23 people (76.7%), came from mothers who experienced anemia as many as 16 people (53.3%), came from mothers who did not experience bleeding antepartum as many as 25 people (83.3%), and came from mothers who had amniotic fluid early rupture as many as 22 people (73.3%).

Bivariate Analysis

Table 4. The Relationship between Preeclampsia and Neonatal Asphyxia at Dr. M. Djamil Padang Year 2021

Variable	Incidence of Asphyxia				Amount		p
	Severe		Moderate		f (n=132)	%	
	f (n=30)	%	f (n=102)	%			
Preeclampsia							
Preeclampsia	18	40,0	27	60,0	45	100,0	0,001
Not preeclampsia	12	13,8	75	86,2	87	100,0	
Premature Birth							
Premature Birth	23	29,5	55	70,5	78	100,0	0,044
Normal	7	13,0	47	87,0	54	100,0	
Anemia in Mother							
Anemia	16	17,2	77	82,8	93	100,0	0,035
Not anemic	14	35,9	25	64,1	39	100,0	

Antepartum Bleeding	5	15,6	27	84,4	32	100,0	0,390
Yes	25	25,0	75	75,0	100	100,0	
No							
Premature rupture of membranes	22	45,8	26	54,2	48	100,0	0,000
Yes	8	9,5	76	90,5	84	100,0	
No							

Based on the table above, it shows that there is a significant relationship between preeclampsia, premature birth, prenatal anemia, and premature rupture of membranes with the incidence of neonatal asphyxia and there is no significant relationship between antepartum hemorrhage and the incidence of neonatal asphyxia at RSUP Dr. M. Djamil Padang in 2021.

Table 5. Logistic Regression Test Results

Variable	P	OR
Preeclampsia	0,160	0,193
Premature Birth	0,064	2,627
Premature rupture of membrane	0,003	34,988

Based on table 5 above, it shows that the variable premature rupture of membranes has a p-value of 0.003 and the largest OR is 34.988. So, it can be concluded that the most dominant variable that significantly influences the incidence of neonatal asphyxia is premature rupture of membranes in RSUP Dr. M. Djamil Padang in 2021.

DISCUSSION

Relationship between Preeclampsia and Neonatal Asphyxia

There is a relationship between preeclampsia and neonatal asphyxia. This study is the same as research by Riani & Kanony (2022) that there is a relationship between preeclampsia and the incidence of asphyxia in newborns at the Pertiwi Mother and Child Hospital in Makassar. The results of statistical tests using chi square obtained a p value = 0.001, less than 0.05. In line with research conducted by Elvira, et al (2022) that there was a relationship between preeclampsia and the incidence of asphyxia in newborns with an OR value of 2.899, which means that asphyxia has a risk of 2.899 times occurring in respondents who have preeclampsia compared to respondents who do not experience preeclampsia (Amokrane et al., 2016).

Preeclampsia is a complex condition related to the blood vessels of the mother, fetus and placenta that experience pathological changes, including decidual arteriopathy, dead tissue, ischemic changes and abruption, so it is said that perinatal outcomes are affected by these events. Other causes for preeclampsia are mostly related to placental problems such as injury to the placenta. The underlying vascular indications, and the presence of oxidative stress and endothelial obstruction, will affect uteroplacental outflow and may result in limited development in the fetus with hypoxia and acidosis leading to intrauterine fetal death (IUFD). In infants it causes asphyxia and several other complications can be at risk of death (Mochtar, 2018).

Preeclampsia results in vasoconstriction so that blood pressure increases which causes reduced blood delivery to the placenta and limits the amount of oxygen and nutrients available to the fetus. As a result, fetal development slows down, and intrauterine hypoxia occurs, even more fatal, preeclampsia can cause sudden detachment of placental tissue from the uterus prematurely. A further consequence of fetal hypoxia is impaired gas exchange between oxygen and carbon dioxide resulting in neonatal asphyxia.

The Relationship between Premature Birth and Neonatal Asphyxia

There is a significant relationship between premature birth and neonatal asphyxia. This is similar to the results of a study conducted by Amalia (2020) concerning the factors associated with the incidence of neonatal asphyxia. The results of the statistical test between prematurity and neonatal asphyxia were p value $0.003 < 0.05$ indicating that there is a significant relationship between prematurity and neonatal asphyxia. asphyxia neonatorum at RSI Siti Khadijah Palembang. The Odds Ratio results obtained were 4.433, meaning that respondents who experienced prematurity had a 4.4 times chance compared to respondents who did not experience prematurity in the incidence of neonatal asphyxia (Portiarabella et al., 2021).

Premature birth is labor that occurs between 28 weeks' gestation to less than 37 weeks (259 days), counting from the first day of the last menstruation in a 28-day cycle (Goodman et al., 2014). Babies born before 37 weeks' gestation are said to be premature and can experience various problems during the neonatal period. Premature birth demands adaptation to extrauterine life before these organ systems develop adequately. Such babies cannot maintain body temperature or suck and swallow. Infants born prematurely are also more likely to suffer from intrapartum asphyxia and respiratory failure after birth due to immature lung structure and function (Mappa et al., 2020).

Premature babies are more at risk of dying from asphyxia. Generally, disturbances have started since in the womb, for example fetal distress or fetal stress during labor. Respiratory failure in premature infants is associated with surfactant maturity deficiency in the infant's lungs. Premature babies have different characteristics from full-term babies, both in terms of anatomy and physiology. These characteristics are surfactant deficiency causing difficulty during ventilation, immature brain development resulting in less ability to trigger breathing, weak muscles making it difficult to breathe spontaneously, thin skin, wide skin surface and skin fatty tissue that makes it easier for babies to lose breath, babies are often born accompanied by infection, less blood volume is increasingly susceptible to blood loss, immature tissue that is easily damaged due to lack of oxygen.

The Relationship of Anemia in Mothers with the Incidence of Asphyxia Neonatorum

There is a significant relationship between prenatal anemia and the incidence of neonatal asphyxia. In line with Sari's research, et al (2022) using a bivariate analysis of the relationship between anemia in mothers and the incidence of neonatal asphyxia at Hasanuddin Damrah Manna General Hospital using the chi square test obtained p value = $0.000 < 0.05$, it is significant, then H_0 is rejected and H_a is accepted. So, there is a relationship between prenatal anemia and the incidence of neonatal asphyxia at Hasanuddin Damrah Manna General Hospital. The results of the Risk Estimate test obtained an Odds Ratio value = 3,434 which means that anemia in mothers has a 3,434 times greater chance of causing neonatal asphyxia when compared to mothers who do not have anemia (Sirenden et al., 2018).

Anemia in pregnant women results in reduced blood flow to the placenta so that oxygen and nutrients are increasingly unbalanced to meet metabolic needs. Consumption of oxygen to the fetus is not fulfilled because the ability to transport oxygen has decreased. Anemia in pregnant women causes placental hypertrophy as compensation for hypoxia and results in decreased volume and surface area of the placenta due to infarction, intervillous thrombi and classification so that the diffusion capacity of the placenta is disrupted, uteroplacental circulation insufficiency occurs which results in decreased oxygen supply to the fetus resulting in neonatal asphyxia.

Anemia in pregnant women occurs if the mother's Hb level in the third trimester, which was last measured before delivery, was <11gr/dl. Anemia in pregnancy causes obstacles to the formation of hemoglobin so that the amount of hemoglobin in the blood cannot keep up with the increase in blood plasma volume. Anemia in pregnancy causes the transport of oxygen to the fetus to be disrupted. This disorder can cause hypoxia in the fetus in the womb so that at the time of birth it can cause neonatal asphyxia.

Relationship between Antepartum Bleeding and Neonatal Asphyxia

There is no significant relationship between antepartum bleeding and neonatal asphyxia. In line with Wahyuni & Fauzia's research (2017) that out of 9 people who experienced antepartum bleeding, most of them gave birth to asphyxia babies, namely 5 babies (55.6%) and of the 41 people who did not experience antepartum bleeding, they gave birth to asphyxia babies, namely 29 babies (70.7%). The relationship between antepartum bleeding and neonatal asphyxia can be seen from the p value of 0.442 greater than 0.05, which means that there is no significant or no relationship between antepartum bleeding and asphyxia (Darulis et al., 2021).

Antepartum bleeding is vaginal bleeding that occurs between the 20th week of pregnancy and the time of delivery. Antepartum hemorrhage causes high maternal and neonatal mortality. In late pregnancies, quite a lot of vaginal bleeding can occur due to the detachment of the placenta from the uterine wall (placenta abruption), and tearing of the placental implantation that covers part or all of the birth canal (placenta previa) [22]. Although it cannot be prevented, early diagnosis and good management can increase the chances of maternal and neonatal survival (Demissie et al., 2018).

In mothers who do not experience antepartum bleeding but the baby has asphyxia, it can be due to many other factors, both from the mother's condition, the baby's condition, the placenta factor and the delivery factor. Maternal factors such as preeclampsia, anemia, severe infections, and postdate pregnancy. Factors in the state of the baby include prematurity, congenital abnormalities, and amniotic fluid mixed with meconium. Placental factors such as cord entanglement, short cord, cord knots, and cord prolapse. Neonatal factors include respiratory depression due to anesthetic drugs or analgesics given to the mother, and birth trauma such as intracranial hemorrhage. Labor factors are prolonged or obstructed labor, labor with complications (breech position, twins, shoulder dystocia, vacuum extraction, forceps), and premature rupture of membranes.

Relationship between premature rupture of membranes and neonatal asphyxia

There is a significant relationship between premature rupture of membranes and the incidence of neonatal asphyxia. In line with research conducted by Sari, et al (2022) from the results of the chi square statistical test (continuity correction) it was found that the value $X^2 = 32,288$ with a p value = 0.000 < 0.05 is significant, then H_0 is rejected and H_a is accepted. So, there is a relationship between premature rupture of membranes in mothers and the incidence of neonatal asphyxia at Hasanuddin Damrah Manna Hospital.

The results of the Risk Estimate test obtained OR = 4,711, which means that premature rupture of membranes has the opportunity to cause asphyxia neonatorum by 4,711 times compared to those who do not experience premature rupture of membranes (Martini, 2021).

Premature rupture of membranes (PROM) is the state of rupture of the amniotic membranes before delivery. Under normal circumstances the membranes will rupture in the process of delivery. The amniotic membranes function to produce amniotic fluid and protect the fetus against infection.

KPD will be at risk of causing infection in the mother which will have a high impact on increasing age, decreasing function and condition of the uterus such as the fertility rate of uterine tissue is reduced for the process of embryogenesis, the formation of amniotic membranes becomes thin and results in rupture of the amniotic fluid before there are signs of labor so that the volume of amniotic fluid decreases during labor. A less volume of amniotic fluid can cause compression of the umbilical cord resulting in decreased O₂ levels for the fetus and increased CO₂ levels, stimulation of the vagus nerve occurs which causes slowing of fetal heart sounds.

One of the neonatal disorders that occur due to premature rupture of membranes is asphyxia. This happens because of the emphasis on the umbilical cord. Premature rupture of membranes can cause 3 things, one of which is maternal infection. Normal infection causes the formation of gram-negative cells, which then integrate and produce an endotoxin which then causes a strong vasospasm in the veins, resulting in seepage of fluid from the vascular space into the extravascular space so that the circulating blood volume is less. The oxygen that the fetus receives is also reduced and hypoxia occurs so that when the baby is born it experiences asphyxia.

CONCLUSION

Based on the results of research conducted on the Main Causal Factors Associated with the Incidence of Asphyxia Neonatorum, it can be concluded that the majority of infants with asphyxia are in the moderate asphyxia classification of 77.3%. Babies who experienced severe asphyxia were mostly from mothers with preeclampsia by 60.0%, premature births by 76.7%, mothers who experienced anemia by 53.3%, mothers who did not experience antepartum bleeding by 83.3%, and mothers with premature rupture of membranes by 73.3%. There is a significant relationship between preeclampsia, premature birth, prenatal anemia, and premature rupture of membranes and there is no significant relationship between antepartum hemorrhage and the incidence of neonatal asphyxia at RSUP Dr. M. Djamil Padang in 2021. The most dominant factor influencing the incidence of neonatal asphyxia is premature rupture of membranes.

It is hoped that health workers can maintain and improve patient health services, especially asphyxia neonatorum.

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