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# 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

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#### BACKGROUND

The level of public health in a country, as well as the quality of life within a community, can be discerned by examining the infant mortality rate (IMR), which serves as a pivotal indicator. Infant mortality, primarily concentrated in the neonatal period, poses a significant health risk for infants aged less than one month. This vulnerable age group faces various health challenges, some of which can be fatal if not promptly addressed. According to data from the World Health Organization (WHO, 2016), neonatal deaths accounted for 2.6 million cases globally. In 2018, the United Nations Children's Fund (UNICEF) reported an average of 18 neonatal deaths per 1,000 live births worldwide (Bohren et al., 2019).

In 2019, asphyxia emerged as the second leading cause of neonatal mortality, following low birth weight (LBW) (Abdo et al., 2019). Shockingly, data indicates that between 4 to 9 million newborns experience asphyxia annually. Furthermore, the incidence of neonatal asphyxia tends to be higher in developing countries, ranging from 4.6 to 20 cases per 1,000 births, as compared to developed nations (WHO, 2016). According to the 2019 Indonesia Health Profile data, asphyxia accounted for 27.4% of neonatal deaths in Indonesia. Within the West Sumatra Province, official data from the Indonesian Ministry of Health in 2020 reported 151 cases of neonatal deaths attributed to asphyxia, ranking West Sumatra third among the Sumatran regions, following Aceh with 278 cases and North Sumatra with 178 cases. In the city of Padang, there were 21 reported cases of asphyxia in 2019 and 11 cases in 2020 (Anisa et al., 2017). Furthermore, a preliminary survey conducted at RSUP Dr. M. Djamil Padang in 2020 revealed 98 cases of neonatal asphyxia, with an anticipated increase to 139 cases in 2021.

Neonatal asphyxia arises in situations where newborns are unable to breathe spontaneously and regularly due to insufficient oxygen supply, characterized by hypoxia, hypercarbia, and acidosis (Portiarabella et al., 2021). Complications stemming from asphyxia can result in life-threatening conditions such as hypoxic-ischemic encephalopathy, brain injury, autism, attention deficit hyperactivity disorder, seizures, and cerebral palsy. Surviving infants often grapple with lifelong health challenges, with 80% facing disabilities, developmental delays, paralysis, intellectual impairments, and behavioral issues (Abdo et al., 2019).

The causative factors behind neonatal asphyxia encompass antepartum factors, intrapartum factors, and fetal factors. Antepartum risk factors include conditions like preeclampsia, oligohydramnios, antepartum bleeding, anemia, inadequate antenatal care (ANC) visits, maternal age below 20 or above 35 years, and low educational status. Intrapartum risk factors encompass breech presentation, premature rupture of membranes, prolonged second-stage labor, obstructed labor, and meconium aspiration syndrome. Fetal risk factors include low birth weight, premature birth, multiple pregnancies, umbilical cord entanglement, resuscitation, and fetal distress (Portiarabella et al., 2021).

Preeclampsia plays a pivotal role in the development of neonatal asphyxia, as it is associated with blood vessel constriction, resulting in compromised blood gas exchange and nutrient delivery (World Health Organization, 2018). Some mothers experiencing preeclampsia give birth to infants with asphyxia due to impaired placental function, leading to vasoconstriction of placental blood vessels and subsequent fetal hypoxia. The consequences of fetal hypoxia include impaired gas exchange, ultimately culminating in neonatal asphyxia (Miyaoka et al., 2005).

Premature birth places infants at risk of respiratory complications, as their lungs are underdeveloped and respiratory muscles are not fully functional. Moreover, premature infants, with a gestational age of less than 37 weeks, lack adequate surfactant levels, making them susceptible to neonatal asphyxia, as surfactant is crucial for maintaining alveolar stability (Dimkpa & Oji, 2010).

Prenatal anemia emerges as another significant factor linked to neonatal asphyxia. Anemia in pregnant women, defined by maternal hemoglobin levels below 11 g/dl in the third trimester, impedes hemoglobin production, resulting in an inadequate oxygen transport capacity to the fetus. This disruption can cause fetal hypoxia in utero, subsequently leading to neonatal asphyxia (Tasaw et al., 2018).

Antepartum hemorrhage is a recognized risk factor for asphyxia, with mothers experiencing antepartum bleeding having a 12-fold higher risk of giving birth to asphyxiated infants compared to those without such bleeding (Tasaw et al., 2018; Tunggal et al., 2022). Antepartum bleeding can diminish blood flow from the mother to the placenta, resulting in fetal hypoxemia.

Premature rupture of membranes (PROM), defined as membrane rupture before delivery with cervical dilation less than 3 cm for primiparas and less than 5 cm for multiparas, poses another risk for asphyxia. PROM increases the likelihood of maternal infections, affecting uterine function and amniotic membrane integrity, ultimately leading to a decrease in amniotic fluid volume. Inadequate amniotic fluid levels can compress the umbilical cord, reducing oxygen levels for the fetus and increasing carbon dioxide levels, potentially leading to asphyxia (Martini, 2021).

Based on the aforementioned factors, our study aims to further investigate the primary causative factors associated with the incidence of neonatal asphyxia at Dr. M. Djamil Padang in 2021.

# **OBJECTIVE**

In our pursuit of a comprehensive understanding of neonatal asphyxia, this study addresses a series of pivotal research questions. Firstly, we delve into the antepartum factors, encompassing variables such as preeclampsia, antepartum hemorrhage, and anemia, to decipher their individual and collective contributions to neonatal asphyxia. Secondly, we explore intrapartum risk factors, namely premature rupture of membranes, aiming to unravel their significance in precipitating neonatal asphyxia. Thirdly, we investigate fetal risk factors, namely preterm birth, aiming to discern their roles in the genesis of neonatal asphyxia. Finally, we synthesize these findings to gain a comprehensive understanding of the main factors associated with neonatal asphyxia at Dr. M. Djamil Padang in 2021, with the ultimate goal of contributing to neonatal healthcare knowledge and informing strategies for prevention and intervention to enhance neonatal outcomes.

# **METHODS**

This research employs a quantitative approach with a cross-sectional design, conducted within the Medical Records sub-section of RSUP Dr. M. Djamil Padang. The study's sample comprises all newborns who encountered neonatal asphyxia at Dr. M. Djamil Padang in 2021, totaling 132 infants, adhering to the established inclusion criteria. The sample collection method employed a total sampling technique. Neonatal asphyxia serves as the dependent variable, while the independent variables encompass

preeclampsia, premature birth, prenatal anemia, antepartum hemorrhage, and premature rupture of membranes.

The research instrument consists of secondary data, specifically newborn medical records from Dr. M. Djamil Padang in 2021, comprising a checklist sheet with columns for patient names, medical record numbers, maternal age, infant age, gender, birth weight, APGAR score, and the presence of preeclampsia, premature birth, prenatal anemia, antepartum hemorrhage, and premature rupture of membranes.

Data analysis includes univariate and bivariate analyses employing the chi-square test to establish relationships between variables, along with multivariate analysis utilizing logistic regression to identify the most dominant independent variable affecting the dependent variable, all reported with a 95% confidence interval.

# 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	2) %			
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

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%).

M. Djamil Padang Year 2021					
Dependent	Severe Asphyxia		Moderate As	sphyxia	
Variable	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	

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

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.

 Diamil Padang Vear 2021

Djamil Padang Year 2021							
	I	Incidence of Asphyxia			Amount		
Variable	Seve	ere	Mode	rate			р
	f	%	f	%	f	%	_
	( <b>n=30</b> )		(n=102)		(n=132)		
Preeclampsia							
Preeclampsia	18	40,0	27	60,0	45	100,0	0,001
Not preeclampsia	12	13,8	75	86,2	87	100,0	
<b>Premature Birth</b>							
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	16	17,2	77	82,8	93	100,0	0,035
Anemia	14	35,9	25	64,1	39	100,0	
Not anemic							
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	22	45,8	26	54,2	48	100,0	0,000
membranes	8	9,5	76	90,5	84	100,0	
Yes							
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	Р	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 arteriolopathy, 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. 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 Ho is rejected and Ha 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 X2 = 32,288 with a p value = 0.000 < 0.05 is significant, then Ho is rejected and Ha 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 findings derived from the investigation into the Primary Causal Factors Linked to Neonatal Asphyxia Incidence, several key conclusions emerge. The majority of infants grappling with asphyxia fall within the moderate asphyxia classification, comprising a substantial 77.3% of cases. Amongst infants experiencing severe asphyxia, a noteworthy 60.0% were born to mothers afflicted by preeclampsia, while a staggering 76.7% were premature births, and 53.3% had mothers facing prenatal anemia. Furthermore, the absence of antepartum bleeding was associated with 83.3% of severe asphyxia cases, and 73.3% were attributed to mothers with premature rupture of membranes. Significantly, the study unveiled a substantial relationship between preeclampsia, premature birth, prenatal anemia, and premature rupture of membranes in connection with neonatal asphyxia. Conversely, antepartum hemorrhage displayed no significant association with the incidence of neonatal asphyxia at RSUP Dr. M. Djamil Padang in 2021. Remarkably, the most influential factor impacting the occurrence of neonatal asphyxia was identified as premature rupture of membranes. These findings underscore the vital importance of healthcare practitioners maintaining and enhancing patient health services, with a particular focus on neonatal asphyxia.

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