



# Risk Factors of Asphyxia in Newborns

Faizatul Ummah<sup>(✉)</sup>, Lilin Turlina, Ati'ul Impartina, and Ihda Mauliyah

Faculty of Health, Universitas Muhammadiyah Lamongan, Lamongan, Indonesia  
faizatul\_ummah@umla.ac.id

**Abstract.** Asphyxia or breathing difficulty after birth is still one of the primary causes of neonatal death in Indonesia. Three-quarters of neonatal deaths occur in the first week, 40% of them die within 24 h after birth. This study aimed to determine the risk factors for the incidence of newborn asphyxia. This research applied an analytical descriptive research design with a case-control approach. The sample size is divided into the case group of 100 newborns with asphyxia and the control group of 100 newborns without asphyxia using simple random sampling. The researchers utilized a checklist to obtain hospital medical records. The dependent variable was newborn asphyxia, while the independent variables were maternal age, parity, gestational age, type of delivery, length of delivery, maternal illness, and birth weight. The data were analyzed by univariate, bivariate, and multivariate with multiple logistic regression at the level of significance ( $\alpha$ ) < 0.05. The results of the bivariate analysis indicated that factors associated with newborn asphyxia were maternal age, gestational age, length of delivery, maternal illness, and baby weight ( $p < 0.05$ ). Parity and the type of delivery were not concerning newborn asphyxia. Multivariate analysis showed that the dominant factors affecting the incidence of newborn asphyxia were gestational age OR 8.320 (95% CI: 3.126–22.146,  $p = 0.000$ ), birth weight OR 6.326 (95% CI: 2.542–15.745,  $p = 0.000$ ), length of delivery OR 4.282 (95% CI: 1.963–9.341,  $p = 0.000$ ), maternal illness OR 3.812 (95% CI: 1.284–11.246,  $p = 0.016$ ), and maternal age OR 2.670 (95% CI: 1.065–6.695,  $p = 0.036$ ). Health workers should make efforts in anticipating the incidence of asphyxia in newborns by recognizing risk factors from pregnancy and childbirth and by taking appropriate asphyxia measures.

**Keywords:** Risk Factors · Asphyxia · Newborn babies

## 1 Introduction

Neonatal mortality rate and infant mortality rate are important indicators to assess the level of the healthy development of a country and the public's quality of life. The infant mortality rate also illustrates the level of public health problems related to the causes of infant mortality, the level of antenatal care, the nutritional status of pregnant women, the success rate of the MCH and family planning programs, and the socio-economic conditions.

Indonesia was one of the 10 countries which received UNICEF's Every Child Alive 2018 campaign. The ten countries were the source of more than half of all newborn

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deaths in the world. The results of the Indonesian Demographic and Health Survey (IDHS) showed that infant and neonatal mortality rates had decreased from year to year, but there was still a long way to go to combat infant mortality. In 2012, the neonatal mortality rate was 19 per 1,000 live births and 32 infant mortality rates per 1,000 live births while in 2017 the neonatal mortality rate fell to 15 per 1,000 live births and the infant mortality rate was 24 per 1,000 live births (Ministry of Health RI, 2018) [1]. The neonatal mortality rate and infant mortality rate obtained from routine reports were relatively small. However, if calculated, the absolute mortality rate was still high, as many as 4,059 babies died per year. This means that in one day there were eleven babies died. The infant mortality rate in East Java in 2017 was 23.6 per 1,000 live births (East Java Provincial Health Office, 2018) [2]. In Lamongan district there were 90 infant deaths in 2016. Many factors affected the infant mortality rate and it was not easy to find the most dominant factor (Lamongan District Health Office, 2017) [3].

Birth asphyxia is the second highest cause of infant mortality after LBW and it is still a problem in both developing and developed countries. According to IDHS (2012), the main causes of early neonatal mortality in Indonesia were low birth weight babies (LBW) at 11%, 33.6% asphyxia, and 31.4% tetanus.

Birth asphyxia is a condition in which the baby fails to breathe spontaneously and regularly immediately after birth. Risk factors for neonatal asphyxia consist of maternal factors, fetal factors, and labor/birth factors. Maternal factors include age, parity, maternal illness such as antepartum bleeding, hypertension, and anemia during pregnancy. Labor factors include the types of delivery, birth attendant, place of delivery, prolonged labor, and premature rupture of membranes. Meanwhile, baby factors include premature, low birth weight, and umbilical cord such as umbilical cord twists, short umbilical cord, and umbilical cord prolapse (Mochtar, 2011) [4]. Research by Widiani, NN Ayuk, et al. (2016) [5] and Rahma, Andi Siti, et al. (2014) [6] showed that some factors that increased the incidence of neonatal asphyxia were umbilical cord twists, anemia during pregnancy, low birth weight, maternal age < 20 years and > 35 years, hypertension during pregnancy, gestational age < 37 weeks and > 42 weeks, prolonged labor, and delivery with action.

Birth asphyxia is accompanied by hypoxia, hypercapnia, and ended with acidosis (Kosim, 2008) [7]. Hypoxic and ischemia conditions that occur due to asphyxia will cause disturbances in various functions of vital organs and experience dysfunction such as brain, lung, liver, kidney, blood system, and gastrointestinal tract. If this process goes too far it can result in death. Long-term effects of infants with severe asphyxia include hypoxic-ischemic encephalopathy, transient myocardial ischemia, tricuspid insufficiency, myocardial necrosis, acute renal failure, acute tubular necrosis, enterocolitis, SIADH (inappropriate antidiuretic hormone syndrome), liver damage, intra-vascular coagulation disseminated (KID), bleeding and pulmonary edema, secondary hyaline membrane disease, and meconium aspiration.

Considering the serious impact of asphyxia on the health, survival, and babies' quality of life, the introduction of risk factors for asphyxia during pregnancy and childbirth is very important.

The risk factors accompanying birth asphyxia allow preparation for resuscitation so that the infant receives adequate therapy. In addition to the introduction of risk factors,

efforts that can be made to reduce neonatal mortality are by increasing the competence of health workers or birth attendants in normal delivery care and neonatal emergency care such as resuscitation of newborns through clinical training activities so that they can provide quality services. This study aimed to analyze the risk factors which predispose to birth asphyxia.

## 2 Research Method

The research design was descriptive-analytic with a case-control approach. The total sample of the study was 200 newborns, divided into a case group (100 babies) and a control group (100 babies) in RSUD Dr. Soegiri Lamongan 2019, which were obtained by simple random sampling. The dependent variable was the incidence of birth asphyxia and the independent variables were maternal age, gestational age, parity, type of delivery, length of delivery, maternal illness/complications before and during labor, and birth weight. The data were collected from secondary data of official hospital documents of dr. Soegiri Lamongan for one year in the form of the respondents' medical record files. The data collection instrument was a checklist. Then, the data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) version 18.0, univariate analysis, bivariate analysis with the Chi-Square test, and multivariate analysis with multiple logistic regression.

## 3 Results

The findings are the result of the study on risk factors for asphyxia in newborns. There three types analysis; i.e. univariate analysis, bivariate analysis, and multivariate analysis as shown in the Table 1.

Based on Table 1, it can be perceived that the maternal age between 20–35 years old in the case group was 70% and in the control group it was 88%. The gestational age of <37 weeks and >40 weeks in the case group was 51% while in the control group the gestational age between 37–40 weeks was 94%. Maternal parity in the case group (56%) and the control group (58%) was categorized as low risk. Based on types of delivery, both the case group (85%) and control group (85%) experienced abnormal labor or by Caesarean section (SC). The length of labor in the case group was mostly (54%) abnormal and almost all of the control group (82%) were normal. Almost all mothers in the case group (93%) had complications/illness during pregnancy and delivery while in the control group most of the mothers (70%) had complications. Most of the babies' birth weight in the case group (53%) was normal and almost all (90%) were normal in the control group.

Sub variables of risk factors for asphyxia in newborns were maternal age, gestational age, parity, types of delivery, length of delivery, maternal illness/complications before and during labor, and birth weight. The bivariate test was performed for candidate selection before the multivariate test using multiple logistic regression tests. The results of the Chi-Square test in Table 2 showed that the variables with p-value < 0.05 were maternal age, gestational age, the length of delivery, maternal illness/complications before and during labor and, birth weight. Meanwhile, the p-value of the parity variable and the type

**Table 1.** Univariate analysis of risk factors for asphyxia in newborns

Variables	Case		Control		Total	
	f	%	f	%	f	%
<b>Maternal Age</b>						
20–35 Years	70	70%	88	88%	158	79%
<20 Years dan > 35 Years	30	30%	12	12%	52	23%
<b>Gestational Age</b>						
37–40 Weeks	49	49%	94	94%	143	71,5%
<37 Weeks dan > 40 Weeks	51	51%	6	6%	57	28,5%
<b>Parity</b>						
Low risk	56	56%	58	58%	114	57%
High risk	44	44%	42	42%	86	43%
<b>Type of Delivery</b>						
Normal	15	15%	20	20%	35	17,5%
Abnormal	85	85%	80	80%	165	82,5%
<b>Length of Delivery</b>						
Normal	46	46%	82	82%	128	64%
Abnormal	54	54%	18	18%	72	46%
<b>Maternal Illness</b>						
Yes	93	93%	70	70%	163	81,5%
No	7	7%	30	30%	37	18,5%
<b>Birth Weight</b>						
Normal (2500 g–4000 g)	53	53%	90	90%	143	71,5%
Abnormal (<2500 g and >4000 g)	47	47%	10	10%	57	28,5%

of delivery was  $> 0.05$  so that the two variables were not included in the multivariate test.

Based on Table 3, it can be perceived that the results of the multiple logistic regression test obtained five independent variables, namely maternal age, gestational age, length of delivery, a maternal illness before and during delivery, and birth weight with p-value  $< 0.05$ . Thus, it can be interpreted that there was a significant influence between maternal age, gestational age, length of delivery, a maternal illness before and during delivery, and birth weight with the incidence of asphyxia in newborns at dr. Soegiri Lamongan. Also, Table 3 shows that the most dominant variable affecting the incidence of birth asphyxia was gestational age OR 8.320 (95% CI: 3.126–22.146,  $p = .000$ ), birth weight OR 6.326 (95% CI: 2.542–15.745,  $p = .000$ ), length of delivery OR 4,282 (95% CI: 1.963–9.341,  $p = .000$ ), maternal illness OR 3.800 (95% CI: 1.284–11.246,  $p = .016$ ), maternal age OR 2,670 (CI 95%: 1.065–6.695,  $p = .036$ ). Gestational age was the most dominant risk

**Table 2.** Bivariate analysis of risk factors for asphyxia in newborns

Variable	Asphyxia	Non Asphyxia	OR	95% CI	p
<b>Maternal Age</b>					
20–35 Years	70	88	2.841	1.116–7.234	.029
<20 Years dan > 35 Years	30	12			
<b>Gestational Age</b>					
37–40 Weeks	49	94	8.785	3.274–23.572	.000
<37 Weeks dan >40 Weeks	51	6			
<b>Parity</b>					
Low risk	56	58	3.257	.654–16.216	.149
High risk	44	42			
<b>Type of Delivery</b>					
Normal	15	20	.550	.204–1.483	.237
Abnormal	85	80			
<b>Length of Delivery</b>					
Normal	46	82	4.524	2.015–10.158	.000
Abnormal	54	18			
<b>Maternal Illness</b>					
Yes	93	70	3.939	1.314–11.809	.014
No	7	30			
<b>Birth Weight</b>					
Normal (2500 g–4000 g)	53	90	7.018	2.759–17.856	.000
Abnormal (<2500 g And >4000 g)	47	10			

**Table 3.** Multivariate analysis of risk factors for asphyxia in newborns

Variables	OR	95% CI		p
		Lower Limit	Upper Limit	
Maternal Age	2.670	1.065	6.695	.036
Gestational Age	8.320	3.126	22.146	.000
Length of delivery	4.282	1.963	9.341	.000
Maternal Illness	3.800	1.284	11.246	.016
Birth Weight	6.326	2.542	15.745	.000

factor for the incidence of birth asphyxia compared to other variables, where gestational age < 37 weeks and >40 weeks tended to experience asphyxia 8 times greater than normal gestational age.

## 4 Discussions

### 4.1 The Relationships Between Gestational Age and Asphyxia in Newborns

The results of a bivariate analysis of gestational age with asphyxia in newborns obtained p-value < 0.001 and multivariate analysis OR 8.320 (95% CI: 3.126–22.146, p = .000). It can be interpreted that there was a significant relationship between gestational age and asphyxia in newborns. Newborns at gestational age less than 37 weeks and more than 40 weeks had a risk of asphyxia 8 times greater than those who were born at 37–40 weeks.

The results of this study are relevant to the results of previous studies. Wu Sy, et al. (2019) [8] stated that preterm birth and low birth weight had a higher incidence of experiencing severe asphyxia (p < 0.05). Kusumaningrum, RY, Muthi, B, and Prasetya, H (2019) [9] in their study also found that babies born prematurely had a higher probability of experiencing asphyxia than non-premature babies (OR = 1.27; 95% CI = 1.23 to 10.25; p = 0.019). Nayeri, F, et al (2012) [10] and Aslam, HM, et al (2014) [11] also stated that one of the risk factors for neonatal asphyxia was preterm labor or gestational age < 37 weeks (OR 0.34 95% CI 0.19–0.58).

Babies born at a gestational age less than 37 weeks are more at risk of experiencing respiratory problems because their lung organs are not yet functioning properly. They may experience a lack of surfactant, including weak respiratory muscles. This causes babies born prematurely to be less able to adapt to gas changes and respiratory distress or asphyxia occurs. Unlike premature babies, babies born more than 40 weeks often experience asphyxia due to reduced blood flow to the fetus and reduced function of the placenta. Lack of oxygen during the intrauterine period results in fetal hypoxia and distress, which is then born with an asphyxic condition. The results of the research by Lestari, RD, and Putri, NN (2019) [12] stated that post-term pregnancy was 0.6 times more likely to experience birth asphyxia than term pregnancy with OR 0.673 (95% CI 0.256–1,766).

### 4.2 The Relationships Between Birth Weight and Asphyxia in Newborns

The results of bivariate analysis between birth weight and asphyxia in newborns obtained p-value < 0.001 and multivariate analysis birth weight OR 6.326 (95% CI: 2.542–15.745, p = .000). This means that birth weight had a significant relationship with the incidence of asphyxia in newborns. A birth weight that is less or greater than normal (<2,500 and >4000 g) tended to experience asphyxia in newborns 6 times greater than normal weight.

The results of this study are following the research of Gebreheat, G et al. (2018) [13] at Tigray General Hospital in Ethiopia who explored that neonates weighing less than 2.5 kg were 12.75 times more likely to experience birth asphyxia compared to those who weigh 2,394 kg (AOR 12.75: CI: 4.05–40.08). Widiani, NN, Ayuk et al. (2016) [5] reported that low birth weight increased the risk of neonatal asphyxia at Sanglah Hospital

Bali (AOR = 3.41, 95% CI: 1.61–9.18). Likewise, a research report by Herianto (2012) [14] stated that low birth weight was a risk factor for neonatal asphyxia with an OR-3.5 (95% CI: 1.56–7.86). However, it is different from the results of Utami's (2015) [15] research which showed that there was no significant relationship between birth weight and the incidence of neonatal asphyxia (p-value = 0.600 or greater than 0.05).

Birth weight between <2500 g and >4000 g have a greater risk of neonatal asphyxia. Low birth weight tends to have problems in the body system due to unstable body conditions including difficulty in breathing, asphyxia, and aspiration. According to Proverawati and Ismawati (2010) [16], babies with low birth weight either due to prematurity or full-term birth with a small gestation period can experience respiratory adaptation process disorders at birth so that they are easier to experience neonatal asphyxia. This condition is worsened by preterm infants. Moreover, if the body weight is low, then the prognosis will get worse. In large babies (>4000 g), the uterus during pregnancy will experience excessive distension. This will affect uterine contractions and the length of labor. If the baby is born vaginally, it will be at risk of congestion and dystocia. According to Saifuddin (2014) [17], labor with a stretched uterus requires special attention to fetal distress. Large babies or macrosomia are more at risk of shoulder dystocia, in which one of the complications is hypoxia.

### 4.3 The Relationships Between Length of Delivery and Asphyxia in Newborns

The results of the bivariate analysis obtained p-value < 0.001, which means that there was a relationship between the length of delivery and asphyxia in newborns, and the results of multivariate analysis OR 4,282 (95% CI: 1.963–9.341, p = .000) indicated that long labor increased the risk of asphyxia 4 times greater than the normal labor.

The results of research by Altman, M, et al. (2015) [18] concluded that prolonged labor at the second stage was associated with a low APGAR score in the first five minutes. Gebreheat, G, et al. (2018) [13] also mentioned that one of the risk factors for high perinatal asphyxia at Tigray General Hospital was long labor duration (AOR, 3.33; CI: 1.32–8.38).

Likewise, Utami's research (2015) [15] stated that there was a significant relationship between the length of delivery and the incidence of birth asphyxia. Labor duration that lasted more than 12 h had a 20 times chance of asphyxia compared to labor duration less than 12 h, AOR = 20.04; 95% (CI = 7,655–52,475; p = 0,000). According to Nurjasmii, E, et al. (2016) [19], one of the causes of birth asphyxia from maternal factors is prolonged labor or obstructed labor.

### 4.4 The Relationship Between Maternal Illness and Asphyxia in Newborns

Maternal illness or complications during pregnancy and/or childbirth in this study included pre-eclampsia, premature rupture of membranes, pelvic constriction, chronic hypertension, antepartum bleeding, hydramnios, oligohydramnios, obesity, asthma, heart disease, and positive HBsAg. The results of the bivariate analysis showed that maternal disease/complications were significantly associated with the incidence of asphyxia in newborns (p < 0.01). The results of the multivariate analysis indicated OR 3.800 (95% CI: 1.284–11.246, p = .016), which means that mothers with maternal

illness/complications during pregnancy and/or childbirth had a tendency 3 times greater to experience birth asphyxia compared to mothers without illness/complications.

The results of research by Marwiyah (2016) [20] in dr. Dradjat Prawiranegara Serang stated that there was a relationship between pregnancy diseases (anemia, hypertension, mild preeclampsia, severe preeclampsia, and eclampsia) and the incidence of neonatal asphyxia ( $p = 0.025$ ). Most of the illnesses/complications of pregnancy were severe preeclampsia (45.8%). While the research of Widiani, NN, Ayuk (2015) [5] stated that the risk factors from mothers were pregnancy hypertension (OR = 1.99; 95% CI: 1.04–3.81) and premature rupture of membranes. (OR = 2.92; 95% CI: 1.50–5.67). According to Mochtar (2011) [4], antepartum and intrapartum factors that increased the risk of neonatal asphyxia including illness, fever during pregnancy, hypertension in pregnancy, anemia, diabetes mellitus, liver and kidney disease, collagen and blood vessel disease, antepartum bleeding, and meconium in the amniotic, and premature rupture of membranes.

#### 4.5 The Relationships Between Maternal Age and Asphyxia in Newborns

Maternal age, both in the case group and in the control group, were most at low risk, namely between 20–35 years, which was a good period for reproduction. However, the results of this study indicated that the incidence of asphyxia in newborns occurred at both risk and high-risk maternal age. From the results of the bivariate test, it was found that there was a significant influence between maternal age and the incidence of asphyxia in dr. Soegiri Lamongan ( $p = 0.02$ ) and the results of the multivariate test showed that high-risk maternal age tended to stimulate the incidence of asphyxia in newborns almost three times greater than low-risk maternal age OR 2,670 (CI 95%: 1.065–6.695,  $p = .036$ ).

The results of previous studies by Widiani, NN, Ayuk, et al. (2016) [5] showed that the significant variables related to birth asphyxia were maternal age < 20 years and > 35 years with AOR = 3.57 (95% CI: 1, 48–8.61). However, it is different from the results of the study Aslam HM, et al. (2014) which stated that maternal aged 20–25 years had a higher risk of experiencing birth asphyxia compared to mothers who are younger or older (<20 or >25) OR 0.30 (CI 95% 0.07–1.21). According to Saifuddin, AB (2014) [17], the safe age for pregnancy and childbirth is 20–30 years. At this age, the reproductive organs function optimally so that the likelihood of complications is lower. Too young or too old (>35 years) mothers were at risk of experiencing complications, such as premature birth, premature rupture of membranes (Rochati, P, 2003). [As explained above, prematurity and premature rupture of membranes is associated with an increased incidence of birth asphyxia.

## 5 Closings

Based on the results of the study, it can be concluded that some factors associated with the incidence of asphyxia in newborns are maternal age, gestational age, length of delivery, pregnancy, and maternal illness/complications, and birth weight the incidence of asphyxia in newborn. Gestational age is the most dominant risk factor for birth asphyxia.



It is recommended for health workers to increase early detection of risk factors for the incidence of birth asphyxia during pregnancy and childbirth through quality antenatal care, close supervision of fetal well-being during delivery, clean and safe delivery assistance, and readiness in handling newborn asphyxia.

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