# Risk Factors for Neonatal Asphyxia Occurrence at General Hospital Dr. M. Soewandhie, Surabaya

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## Abstract

**Background:** Neonatal mortality rates in Indonesia are still high at 15 per 1000 live births. Surabaya is one of the regions with the highest number of neonatal deaths in East Java. Neonatal asphyxia is the highest cause of neonatal death after preterm birth. Some factors that cause neonatal asphyxia include maternal factors, labor and fetal factors. This study aims to identify the risk factors that influence the incidence of neonatal asphyxia.

**Method:** This medical-based study using a case-control approach used neonatal medical record data that was born in the period of January 1, 2018, to December 31, 2018, in the General Hospital of dr. M. Soewandhie, Surabaya. Samples were selected based on inclusion and exclusion criteria. Sampling was done by total sampling in the case group (93 neonates) and simple random sampling in the control group (93 neonates) and matching was done based on sex and birth month. Data analysis was performed by univariate, chi-square and fisher's exact test and multivariate with multiple logistic regression.

**Results:** Neonates with diagnosed neonatal asphyxia were born to mothers who had low education (63.4%) and did not work (68.8%). Risk factors that significantly increased the incidence of neonatal asphyxia were: non-spontaneous labor with OR=5.56 (95%CI: 2.50-12.34), preeclampsia with OR=2.52 (95%CI: 1.15-5.54), meconium-stained amniotic fluid with OR=2.51 (95%CI: 1.17-5.38) and primiparous parity with OR=2.15 (95%CI: 1.06-4.39).

**Conclusion:** Non-spontaneous labor, preeclampsia, *meconium*-stained *amniotic fluid* and primiparous parity affect the incidence of neonatal asphyxia.

**Keywords:** *Neonatal asphyxia, non-spontaneous labor, preeclampsia, meconium-stained amniotic fluid, primiparous.*

## Introduction

The number of child deaths under five years is as many as 5.4 million children with an under-five mortality rate of 39 per 1,000 live births, as much as 47% of these deaths occur in neonatal, which is 18 per 1,000 live births[1]. The neonatal mortality rate in Indonesia is 15 per 1000 live births. This figure is still quite far from the Sustainable Development Goals (SDGs) target, which is to reduce neonatal mortality to a minimum of 12 per 1,000 live births[2]. Neonatal mortality rates in East Java experienced an insignificant decrease from 2015 to 2017[3] with neonatal asphyxia as the highest cause of neonatal death after preterm birth[4].

Neonatal asphyxia is a result of intrapartum hypoxia/ischemia of the fetus and resuscitation measures which

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can immediately restore the condition of the newborn[5]. This condition results in malfunctioning of vital organs, brain damage to death[6]. Causes of neonatal asphyxia include hypertension in pregnancy, post-term pregnancy, maternal narcotics during labor, uterine contractions (hypertonic or tetania uterine), disorders of the umbilical cord and hypovolemic shock[7]. Risk factors for neonatal asphyxia include maternal age, maternal education, parity, anemia during pregnancy, prolonged labor, premature rupture of membranes, low birth weight[8] and very low birth weight in neonates[9]. Preeclampsia in pregnancy can increase the risk of neonatal asphyxia[10]. Obesity in pregnant women also increases the incidence of severe asphyxia in neonates[11].

This study aims to identify risk factors for the incidence of neonatal asphyxia so that it is expected to be prevented and reduced.

## Material and Method

This was medical-based research with a case-control approach. The population in this study were neonates born at the General Hospital of dr. M. Soewandhie, Surabaya in the period January 1, to December 31, 2018, obtained from medical records. The inclusion criteria for case samples were neonates born with neonatal asphyxia diagnoses and had complete medical record data and could be read by the author. The inclusion criteria for the control sample were neonates who were born without neonatal asphyxia and had complete medical record data and could be read by the author. The exclusion criteria in this study were neonates born with congenital abnormalities such as congenital heart defects and diaphragmatic hernias. The sampling technique was total sampling in the case group and simple random sampling in the control group and matching was done based on sex and birth month. Samples obtained were 186 neonates divided into 93 cases and 93 controls. The variables in the study consisted of the dependent variables namely neonatal asphyxia and independent variables namely parity, maternal age, prematurity, birth weight, obesity, anemia during pregnancy, preeclampsia, type of labor, premature rupture of membranes (PROM), prolonged labor and *meconium*-stained *amniotic* fluid (MSAF). Data were analyzed by univariate, Chi-Square and Fisher's Exact Test and multivariate (Backward Stepwise: Likelihood Ratio) using a statistical program (SPSS version 16).

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was one of the largest secondary hospitals in Surabaya. This hospital had 356 patient beds with as many patients (inpatient = 26,590, outpatient = 275,628) per year. There were 104 medical personnel and 527 paramedics.

## Results

The percentage of neonatal asphyxia births was 4.4% (142/3,267). The total sample of cases was 142, as many as 93 samples stated included inclusion criteria. Case and control samples were matched based on sex and birth month of newborns. Table 1 showed that the sex in each case and control group were 52 samples (55.9%) for male and 41 samples (44.1%) for female.

**Table 1: Comparability by sex in the case and control groups**

| Sex of newborns | Neonates | |
|---|---|---|
| | Cases n = 93 (%) | Controls n = 93 (%) |
| Male | 52 (55,9%) | 52 (55,9%) |
| Female | 41 (44,1%) | 41 (44,1%) |

Table 2 showed that as many as 59 (63.4%) case samples and 55 (59.1%) control samples were born to mothers with low education. A total of 64 (68.8%) case samples and 57 (61.3%) control samples were born to mothers who did not work.

**Table 2: Characteristics of mothers based on education and occupation in cases and controls**

| Characteristics | Neonates | |
|---|---|---|
| | Cases n = 93 (%) | Controls n = 93 (%) |
| **Education** | | |
| Low (primary school/middle school) | 59 (63,4%) | 55 (59,1%) |
| High (high school/diploma/bachelor) | 34 (36,6%) | 38 (40,9%) |
| **Occupation** | | |
| Not working (housewife) | 64 (68,8%) | 57 (61,3%) |
| Working | 29 (31,2%) | 36 (38,7%) |

Table 3 showed the results on each of the independent variables that are significantly related to neonatal asphyxia were parity, obesity, preeclampsia, type of labor, prolonged labor and MSAF. The highest crude odds ratio was found in non-spontaneous labor, which was 3.71 (95% CI: 1.81-7.64). As for the variables of maternal age, prematurity, birth weight, anemia and PROM were not related (p-value > α) with the incidence of neonatal asphyxia.

**Table 3 the relationship of risk factors for the incidence of neonatal asphyxia**

| Variables | Neonates | | Crude OR | 95% CI | P-value* |
|---|---|---|---|---|---|
| | Cases n = 93 (%) | Controls n = 93 (%) | | | |
| **Parity** | | | | | |
| Primiparous | 40 (43,0%) | 26 (28,0%) | 1,95 | 1,06-3,58 | 0,032 |
| Multiparous | 53 (57,0%) | 67 (72,0%) | | | |
| **Maternal Age** | | | | | |
| <20 and>35 | 20 (21,5%) | 25 (26,9%) | 0,75 | 0,38-1,46 | 0,392 |
| 20-35 | 73 (78,5%) | 68 (73,1%) | | | |
| **Prematurity (weeks)** | | | | | |
| Premature (<37) | 16 (17,2%) | 10 (10,8%) | 1,73 | 0,74-4,03 | 0,205 |
| Not premature (≥37) | 77 (82,8%) | 83 (89,2%) | | | |
| **Birth weight (gram)** | | | | | |
| <2500 | 14 (15,1%) | 9 (9,7%) | 1,65 | 0,68-4,04 | 0.265 |
| ≥2500 | 79 (84,9%) | 84 (90,3%) | | | |
| **Obesity** | | | | | |
| Yes | 14 (15,1%) | 5 (5,4%) | 3,12 | 1,08-9,05 | 0,029 |
| No | 79 (84,9%) | 88 (94,6%) | | | |
| **Anemia** | | | | | |
| Yes | 6 (6,5%) | 1 (1,1%) | 6,35 | 0,75-53,78 | 0,118 |
| No | 88 (93,5%) | 92 (98,9%) | | | |
| **Preeclampsia** | | | | | |
| Yes | 28 (30,1%) | 15 (16,1%) | 2,24 | 1,10-4,55 | 0,024 |
| No | 65 (69,9%) | 78 (83,9%) | | | |
| **Type of labor** | | | | | |
| Non-spontaneous (CS/VE/Manual Aid) | 35 (37,6%) | 13 (14,0%) | 3,71 | 1,81-7,64 | < 0,001 |
| Spontaneous | 58 (62,4%) | 80 (86,0%) | | | |
| **PROM** | | | | | |
| Yes | 11 (11,8%) | 7 (7,5%) | 1,65 | 0,61-4,46 | 0,321 |
| No | 82 (88,2%) | 86 (92,5%) | | | |
| **Prolonged labor** | | | | | |
| Yes | 9 (9,7%) | 0 (0%) | 2,12 | 1,81-2,46 | 0,003 |
| No | 84 (90,3%) | 93 (100%) | | | |
| **MSAF** | | | | | |
| Yes | 30 (32,3%) | 16 (17,2%) | 2,29 | 1,15-4,58 | 0,017 |
| No | 63 (67,7%) | 77 (82,8%) | | | |

*Chi Square/Fisher's Exact Test

Table 4 showed the results of multivariate analysis with the Backward Stepwise method in order to obtain the final model of multiple logistic regression. Variables with p values <0.25 in the Chi-Square/Fisher's Exact Test were included in the multivariate analysis, which included eight variables. Parity, preeclampsia, type of labor and MSAF were risk factors for neonatal asphyxia.

The analysis showed that the type of labor with non-spontaneous (CS/VE/manual aid) had a risk of 5.6 times to deliver babies with neonatal asphyxia (OR = 5.56; 95% CI: 2.50-12.34) compared to spontaneous labor. The risk of neonatal asphyxia in women with preeclampsia was 2.5 times higher than in women without preeclampsia (OR = 2.52; 95% CI: 1.15-5.54).

Similar to preeclampsia, MSAF also had a 2.5-fold risk of increasing the incidence of neonatal asphyxia (OR = 2.51; 95% CI: 1.17-5.38). Compared to multiparous mothers, mothers with primiparous parity had a 2.1 risk of giving birth to infants with neonatal asphyxia (OR = 2.15; 95% CI: 1.06-4.39).

**Table 4: Results of multivariate regression**

| Variables | B | P-value | Odds Ratio | 95.0% C.I. for OR | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Parity (1) | 0,767 | 0,035 | 2,152 | 1,055 | 4,392 |
| Preeclampsia (1) | 0,924 | 0,022 | 2,519 | 1,146 | 5,540 |
| Type of labor (1) | 1,715 | < 0,001 | 5,555 | 2,500 | 12,343 |
| Prolonged labor (1) | 20,970 | 0,999 | 1,280E9 | < 0,001 | . |
| MSAF (1) | 0,919 | 0,018 | 2,507 | 1,170 | 5,376 |
| Constant | -1,223 | < 0,001 | 0,294 | | |

## Discussion

This study aimed to identify risk factors for neonatal asphyxia, which was by including several determinants that might be risk factors for neonatal asphyxia. Therefore, neonatal asphyxia could be prevented and inherited.

This study showed that neonatal asphyxia mostly occurred in male neonates. This study was in accordance with a study in the United States, which states that 56.2% of neonates with neonatal asphyxia were male. There was no clear theory yet, but this might be related to male vulnerability (XY chromosome) to cerebral anoxia compared to women because there was an additional X chromosome[12].

Maternal characteristics showed that the majority of neonatal asphyxia incidents were born to mothers with low education and no work. This result was in line with a study conducted in Jakarta[13], neonates with neonatal asphyxia were born to mothers with low education (90.6%) and from mothers who did not work by 77.8%. In Northern Ethiopia, the majority of neonatal asphyxia were born to mothers with low education (84.1%) and from mothers who did not work (housewives) by 53.4%[6].

Parity had a significant relationship with the incidence of neonatal asphyxia. Mothers with primiparous parity had a 2.2 times higher risk of giving birth to babies with neonatal asphyxia (OR = 2.15; 95% CI: 1.06-4.39) compared to multiparous mothers. The results of this study differed from studies conducted in Ethiopia, which showed that parity did not affect the incidence of asphyxia[14]. However, another study showed that primiparous mothers had 3.1 times higher risk of giving birth to babies with neonatal asphyxia. This might be related to primiparous mothers who often did not know their pregnancy needs and even ignored antenatal care visits[6]. In the first pregnancy, cervical muscles tended to be stiff so that labor took a long time, which could increase the risk of neonatal asphyxia[15].

Mothers with preeclampsia during pregnancy had 2.5 times the risk of giving birth to neonatal asphyxia babies (OR = 2.52; 95% CI: 1.15-5.54) compared to women who did not experience preeclampsia during pregnancy. This was in line with a study conducted in Ethiopia[6], [14], which showed that preeclampsia increases the risk of the incidence of neonatal asphyxia by 4.1 times and 2.6 times, respectively. The result might be related to changes in the cardiovascular system due to an increase in blood pressure and vascular spasm[10], resulting in placental insufficiency and fetal hypoxia[16].

The type of delivery had a significant relationship with the incidence of neonatal asphyxia. Labor with non-spontaneous (CS/VE/manual aid) had a 5.6 times higher risk of delivering a baby with neonatal asphyxia (OR = 5.56; 95% CI: 2.50-12.34) compared to spontaneous labor. These results were not consistent with a study conducted in Bali[8] but were consistent with studies in Ethiopia which stated that labor with cesarean section had a 7-fold risk of increasing the risk of neonatal asphyxia[14]. This was related to impaired perfusion and vascular resistance due to anesthesia during the

cesarean section and this action also resulted in no chest compressions in infants such as in vaginal delivery[17]. In addition, the used of medical devices such as forceps and or a vacuum extractor during labor could result in trauma and intracranial hemorrhage, which hindered the baby's circulation[16].

*Meconium*-stained *amniotic* fluid at delivery have a 2.5 times higher risk for neonatal asphyxia in infants (OR = 2.51; 95% CI: 1.17-5.38) compared with clear membranes. These results were consistent with studies in Ethiopia[14], which showed that MSAF had a risk of 8.6 times to occurred neonatal asphyxia. The presence of MSAF at delivery indicated that fetal distress had occurred[18]. This results in meconium aspiration syndrome, which resulted in the obstruction of the baby's respiratory tract[15].

The limitation of this study was that it used secondary data, namely medical record data, so that much of the information needed was not available. In addition, this study was only conducted in one hospital in the city of Surabaya, so the study could not be generalized to a wider population.

## Conclusion

Non-spontaneous labor, preeclampsia, primiparous and MSAF are risk factors for neonatal asphyxia. Midwives as a companion for pregnant women and maternity mothers are expected to improve the quality of education and early detection of risk factors. In addition, midwives are expected to be able to carry out close monitoring during labor and identify any complications during labor. Having the right diagnosis and treatment can improve the quality of fetal output.

It is expected that further authors will conduct a more specific study on the incidence of neonatal asphyxia with the factors that influence it. In addition, it is hoped that the community can increase awareness in recognizing high risks in pregnancy and childbirth so that it can reduce morbidity and mortality rates for mothers and infants.

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