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# Risk Factors and Survival in Asphyxia Neonates in Nicu Care of Rsud Daya Makassar

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## ABSTRACT

**Background:** Neonatal asphyxia is one of the diseases that cause neonatal mortality, SDGs have a target to end neonatal mortality which is done by addressing the health problems that cause neonatal mortality itself. The survival of asphyxia neonates is influenced by several factors originating from the mother and fetus.

**Objective:** To analyze the proportion of asphyxia neonate survival, risk factors, *hazard ratio*, and the most dominant factor affecting neonate survival.a

**Methods:** Retrospective cohort study was designed in this study using 351 medical records of neonates who experienced neonatal asphyxia in 2019-2023 at Daya Hospital Makassar City, while to analyze the effect of independent variables on dependent variables, *Cox regression* analysis was conducted as well as to predict the *hazard ratio of* each variable on the survival of neonates who experienced neonatal asphyxia.

**Results:** From all samples, the proportion of neonates who survived was 68%, severe neonatal asphyxia in neonates caused more neonatal mortality. Risk factors that statistically influenced neonates survival were maternal age (HR=1.939, CI=1.270-2.961), premature rupture of membranes (HR=2.005, CI=1.240-3.242), LBW (HR=2.107, CI=1.275-3.479), and prematurity (HR=1.803, CI=1.103-2.945).

**Conclusion:** LBW factor is the most dominant factor affecting neonate survival, thus good maternal knowledge and health services are needed so that good planning can be done long before the pregnancy process occurs, so that dangers and complications during pregnancy can be minimized.

***Keywords:*** *neonatal asphyxia, survival, neonatal mortality, retrospective cohort*

## 1. INTRODUCTION

Neonatal mortality reflects the health status of the community and is the main focus of national health development in line with the SDGs target of reducing neonatal mortality to 12 per 1,000 live births by 2030. The neonatal period (0-28 days) is the most vulnerable period for infant health problems, so the government continues to strengthen delivery services and neonatal care to reduce the risk of death during this period(1) . Globally, the neonatal mortality rate decreased by 53% from 37 to 17 deaths per 1,000 live births between 1990 and 2022, but disparities remain high, with babies in developing countries at 60 times greater risk of death than those in developed countries. In Indonesia, the neonatal mortality rate is estimated at 10.74 per 1,000 live births (UNICEF, 2023), with 18,281 neonatal deaths in 2022, comprising 75.5% of deaths aged 0-7 days and 24.5% aged 8-28 days. In 2023, neonatal deaths accounted for 80.4% of the total 34,226 under-five deaths, with South Sulawesi recording 1,272 deaths and a neonatal mortality rate of 8.8 per 1,000 live births, while Makassar City recorded 63 neonatal deaths with a rate of 2.37 per 1,000 live births (2).

WHO reports that annually about 1 million babies die in the first 24 hours after birth, and 75% of neonatal deaths occur in the first week, most of which are caused by premature birth, complications such as asphyxia, neonatal infections, and congenital abnormalities. In Indonesia, asphyxia is the second highest cause of neonatal death after LBW, accounting for 28.2% of total neonatal deaths in 2022. Globally, neonatal asphyxia causes approximately 900,000 deaths out of 4 million cases per year or equivalent to 23 deaths per 1,000 live births, with the risk of neonatal death in babies who experience asphyxia reaching 3.93 times higher(3) . The proportion of asphyxia mostly occurs in developing countries is 10 times higher

than in developed countries where for developed countries the proportion of asphyxia is 2 per 1000 births, regulating the quality and access to maternal and neonatal nursing is very influential on the proportion of asphyxia in a country(4). The results of research conducted by Kefyalew Taye (2024) concluded that asphyxia has *a* direct effect on neonatal mortality with a risk of 7.29 times (5).

In Indonesia, asphyxia accounts for 25.25% of total neonatal deaths in 2022, with South Sulawesi as the third highest province in cases of neonatal deaths due to asphyxia at 18.70%. At RSUD Daya Makassar, the proportion of neonatal deaths due to asphyxia in the NICU increased from 8.23% in 2020 to 14.7% in 2023, reflecting the serious impact of labor complications on newborn survival (6). Health problems that can be caused by asphyxia are impaired tissue perfusion and then cause hypoxemia and hypercarbia, if not treated quickly and appropriately will cause hypoxic ischemic organ damage, epilepsy, and can also be associated with the development of psychotic syndromes, edema in the lungs and heart problems (7).

Neonatal asphyxia can occur during pregnancy, labor, or immediately after birth, with risk factors including maternal (such as age <20 or >35 years, infection, preeclampsia, prolonged parturition) and fetal (such as prematurity, LBW, malpresentation) conditions. Research shows that mothers aged <20 or >35 years have a 4.96 times higher risk of giving birth to babies with asphyxia than mothers aged 20-35 years, due to immature or declining physical and mental conditions (8). Parity has an association with neonatal asphyxia. Research conducted by Putriani et al. suggested that parity is a factor that significantly affects the survival of asphyxia neonates. Long labor also causes the incidence of neonatal asphyxia. Fekende & Fufa in their study found the results that prolonged labor affects the survival of asphyxia neonates. Long labor has a 4.12 times risk of causing neonatal asphyxia. Where the condition of the oxygen transfer process from mother to baby is disrupted due to uterine contractions and umbilical cord compression which causes neonates to have difficulty breathing so that the heart can beat weakly, become limp and damage the brain and asphyxia at birth which endangers their lives (9).

From research conducted by Andini et al., (2022 ) obtained the results that early rupture of membranes affects the incidence of asphyxia. This is because when the membranes rupture prematurely it will cause oligohydramnios which presses on the umbilical cord, it causes a blockage in the blood flow that flows through the umbilical cord to the fetus. If the supply of blood flow to the fetus is reduced, it will cause oxygen deprivation and increase the risk of neonatal asphyxia at birth (11). Antepartum hemorrhage, which is bleeding after 28 weeks of gestation, has been shown to affect the incidence of neonatal asphyxia. This condition can disrupt utero-placental circulation, inhibit oxygen supply to the fetus, and risk causing fetal distress to neonatal death(12). Preterm infants, those born at ≤37 weeks gestation, have a high risk of neonatal asphyxia due to the immaturity of the lungs that are not yet able to maintain optimal oxygenation. Research shows that premature babies are more susceptible to hypoxia which can damage the nervous system and increase the risk of neonatal asphyxia (13).

Low birth weight (LBW) significantly increases the risk of neonatal asphyxia and neonatal death due to unstable body systems, such as immature breathing and metabolism (14). In addition, postterm pregnancy (≥42 weeks) also triggers neonatal asphyxia due to decreased placental function and the risk of meconium aspiration (15), so further research is needed to evaluate the risk factors and survival rate of asphyxia neonates in the NICU room of Makassar Daya Hospital as a basis for formulating neonatal health intervention strategies.

## 2. PARTICIPANTS & METHODS

This study used an analytic observation design with a *retrospective cohort study* design that utilized secondary data from the medical records of neonates with neonatal asphyxia who had been treated in the NICU room of Daya Hospital Makassar City in 2019 to 2023. The observed variables include maternal factors and fetal factors. The population in this study were all neonates with a diagnosis of neonatal asphyxia who received treatment and had complete medical records in that period, with a total population of 373 neonates. The sample was part of the population who met the inclusion criteria, namely asphyxia neonates with APGAR score <7 who had been treated in the NICU of Daya Hospital Makassar City in 2019-2023 and had complete medical records and contained all the variables needed. The exclusion criteria included neonates with APGAR score >7, and asphyxia neonates with incomplete medical records or did not fulfill all research variables. Based on the Schlesselman formula, the minimum number of samples required was 56 per group with a ratio of 1:1, so that the total minimum sample was 112, which was calculated using Epi Info software. The research instrument was an observation sheet containing the characteristics and variables to be studied. The sample was categorized as *event* if the neonate was declared dead during the treatment period, and as *sensor* if the neonate was declared cured. Data analysis used included univariate, bivariate, and multivariate analysis using the STATA application.

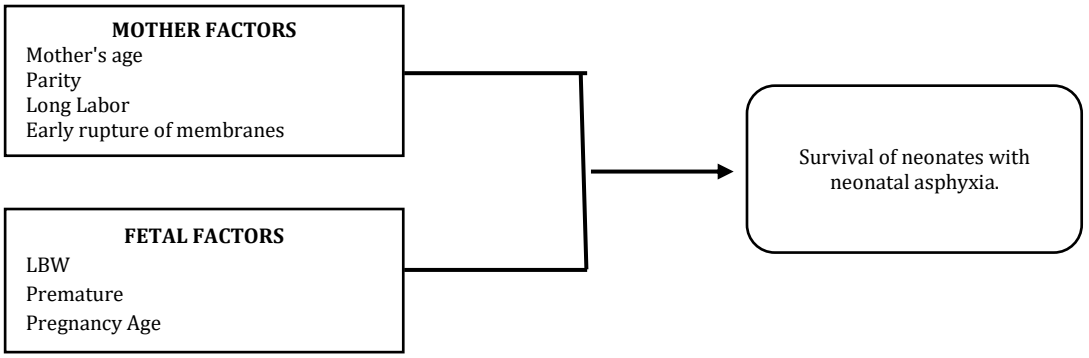


**Figure 1. Research Framework**

## Findings

Makassar City Hospital, which is a hospital owned by the Makassar City Government in accordance with the Mayor's Decree No. 5 of 2007 Year 2007 Regarding the Organizational Structure and Work Procedures of Makassar City Hospital and Makassar Mayor Regulation Number: 54 of 2009 concerning Job Description of structural positions of Makassar City Hospital located at Km 14 Makassar Data and located between residential development areas and Makassar industrial area which makes this RSUD plays an important role in improving health services in the city of Makassar. Makassar City Hospital is a health service that is in charge of providing individual health services in a plenary manner provided by health workers to improve and maintain health, prevent and cure diseases and can restore individuals in the community.

**Table 1. Distribution of Asphyxia Neonates Based on Variable Characteristics in NICU Care at Makassar City Hospital Daya 2019-2023**

| Variable Characteristics | Frequency | | Survival Status | | | |
|---|---|---|---|---|---|---|
| | | | Even | | Sensor | |
| | n (351) | % | n (111) | % | n (240) | % |
| **Survival Status** | | | | | | |
| Event | 111 | 31,6 | 111 | 100 | 0 | 0 |
| Sensor | 240 | 68,4 | 0 | 0 | 240 | 100 |
| **Mother's age** | | | | | | |
| <20 or >35 years old | 174 | 49,6 | 78 | 44,8 | 96 | 55,2 |
| 20-35 years | 177 | 50,4 | 33 | 18,6 | 144 | 81,4 |
| **Parity** | | | | | | |
| Primiparous | 135 | 38,5 | 60 | 44,4 | 75 | 55,6 |
| Multiparous | 216 | 61,5 | 51 | 23,6 | 165 | 76.4 |
| **Long labor** | | | | | | |
| Yes | 220 | 62,7 | 79 | 35,9 | 141 | 64,1 |
| No | 131 | 37,3 | 31 | 24,4 | 99 | 75,6 |
| **Premature rupture of membranes** | | | | | | |
| Yes | 136 | 38,7 | 73 | 53,7 | 63 | 46,3 |
| No | 215 | 61,3 | 38 | 17,7 | 177 | 82,3 |
| **Antepartum hemorrhage** | | | | | | |

| Variable Characteristics | Frequency | | Survival Status | | | |
|---|---|---|---|---|---|---|
| | n (351) | % | Even | | Sensor | |
| | | | n (111) | % | n (240) | % |
| Yes | 176 | 50,1 | 70 | 39,8 | 106 | 60,2 |
| No | 175 | 49,9 | 41 | 23,4 | 134 | 76,6 |
| **LBW** | | | | | | |
| Yes | 196 | 55,8 | 88 | 44,9 | 108 | 55,1 |
| No | 155 | 44,2 | 23 | 14,8 | 132 | 85,2 |
| **Premature** | | | | | | |
| Yes | 157 | 44,7 | 78 | 49,7 | 79 | 50,3 |
| no | 196 | 55,3 | 33 | 17,0 | 161 | 83,0 |
| **Gestational age** | | | | | | |
| <37 or >42 weeks | 192 | 54,7 | 82 | 42,7 | 110 | 57,3 |
| 37- 42 weeks | 159 | 45,3 | 29 | 18,2 | 130 | 81,8 |

Asphyxia neonate mortality was more common in neonates who were born with LBW and premature conditions and had mothers with age <20 or >35 years, mothers with primiparous births, mothers who experienced prolonged labor, premature rupture of membranes, antepartum hemorrhage, and gave birth at gestational age <37 or >42 weeks. The proportion of survival of asphyxia neonates in the NICU of Daya Hospital Makassar City in 2019-2023 can be seen in Table 6, where there was a decrease from the beginning to the end of the study and reached a lift of 0.68%.

### 3. GENERAL CHARACTERISTICS OF NEONATES

The results of descriptive univariate analysis of the general description of neonates based on neonate characteristics including asphyxia category and Gender are described in the following table.

**Table 2 Distibution of Asphyxia Neonates based on Characteristics of Asphyxia Neonates in NICU Care of Makassar Regional Hospital 2019-2023**

| Neonate Characteristics | Frequency | | Survival Status | | | |
|---|---|---|---|---|---|---|
| | | | Event | | Sensor | |
| | n | % | n | % | n | % |
| **Asphyxia** | | | | | | |
| Severe Asphyxia | 153 | 43,6 | 100 | 65,4 | 53 | 34,6 |
| Moderate Asphyxia | 198 | 56,4 | 11 | 5,6 | 187 | 94,4 |
| **Gender** | | | | | | |
| Male | 168 | 47,9 | 56 | 33,3 | 112 | 66,7 |
| Female | 183 | 52,1 | 55 | 30,1 | 128 | 69,9 |
| **Total** | 351 | | 111 | | 240 | |

In table 2, it can be seen that the total samples in this study were 373 neonates who experienced asphyxia in the NICU of Makassar City Daya Hospital, but after matching with the existing inclusion criteria, some samples were excluded so that 351 neonates were left which were then classified into 2 groups of events and sensors. When viewed from the incidence of

death of asphyxia neonates in this study, the classification of asphyxia affects the survival of neonates where besides that neonates with male gender experience more deaths.

## 4. ASSUMPTION TEST OF PH SURVIVAL OF NEONATES WITH ASPHYXIA

The PH assumption is carried out in the *cox regression* test stage as a requirement before conducting *the bivariate cox regression* analysis test and determining the analysis model to be used in the *multivariate cox regression* analysis. After testing the *proportional hasard* assumption (PH assumption) on each variable of maternal age, parity, prolonged labor, premature rupture of membranes, antepartum hemorrhage, premature rupture of membranes, LBW, prematurity and gestational age, it was found that all variables met the PH assumption because the survival lines of the categories did not intersect each other.

The probability of mortality of neonates with asphyxia in the NICU of Daya Hospital Makassar City in this study mostly occurred in the early neonatal period (0-7 days), with the observation time interval during the full neonatal period (0-28 days). The results of *life table* and Kaplan-Meier curve analysis showed that the survival probability of neonates with asphyxia was initially 92% and decreased to 68% at the end of the observation period. This figure is lower than the probability of neonate survival in Surakarta in 2022 of 93%(16) , but equivalent to the figure in northeast Ethiopia in 2022 of 68%(14) . This difference may be caused by variations in physical conditions, environment, socioeconomic, culture, and health care facilities in each study location. In this study, asphyxia was categorized into severe (APGAR 0-3) and moderate (APGAR 4-5) asphyxia, where neonates with severe asphyxia had a higher mortality rate (event) compared to moderate asphyxia. This result is in line with the findings of Jibro et al. who stated that neonates with severe asphyxia have a lower survival rate than those with moderate asphyxia .(17)

### a. Mother's age

The results of Kaplan-Meir curve based on maternal age can be seen in Figure 5 which shows that there is no intersection between categories indicating that the PH assumption is fulfilled thus the maternal age variable can be included in the bivariate analysis. For the proportion of survival in table 7, neonates with mothers who gave birth at the age of <20 or >35 years old are smaller than those aged 20-35 years old, meaning that there is a difference in influence based on maternal age.

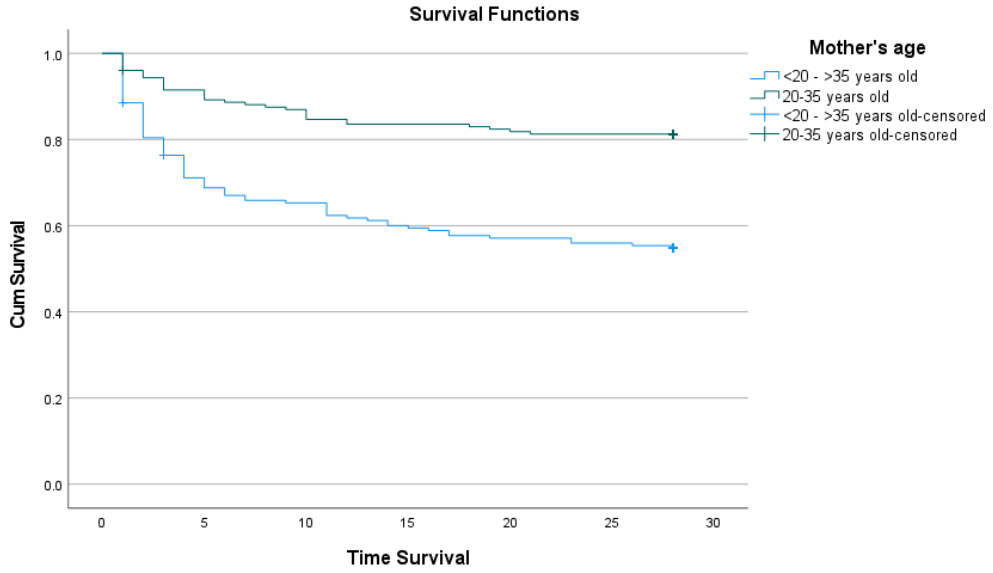


**Figure 2 Proportional curve of survival of neonates with asphyxia by maternal age**

### b. Parity

The results of the *Kaplan-Meier* curve plot of asphyxia neonates in the NICU of Daya Hospital Makassar City in 2019-2023 are shown in Figure 3.

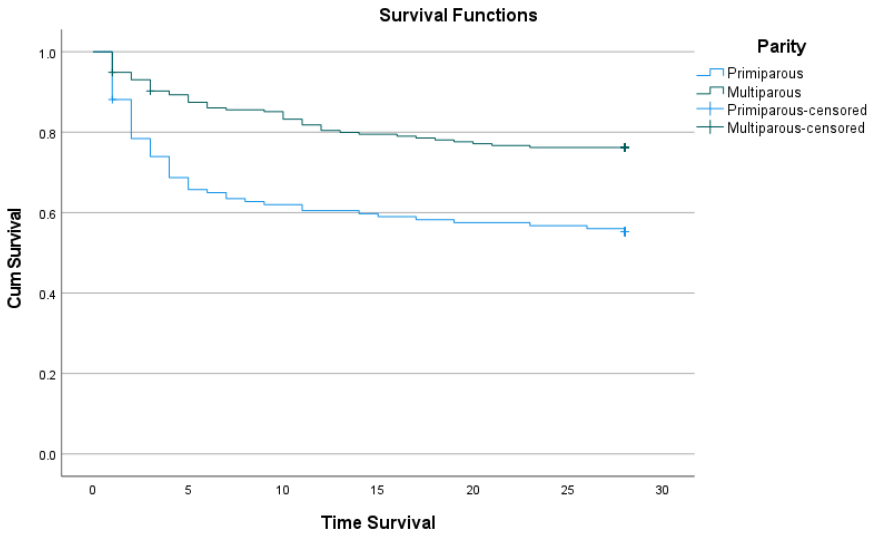


**Figure 3 Survival curve of neonates with asphyxia by parity**

The line on the curve in Figure 3 shows that parity fulfills the assumption of PH and can be done bivariate analysis because there is no intersection between categories, the proportion of survival of asphyxia neonates with multiparous parity is higher than with primiparous.

**c. Long Labor**

The variable of long labor can be done bivariate analysis because it has fulfilled the PH assumption seen in Figure 4 and for the proportion of survival of asphyxia neonates which continues to decrease from the beginning of observation until the end of observation.

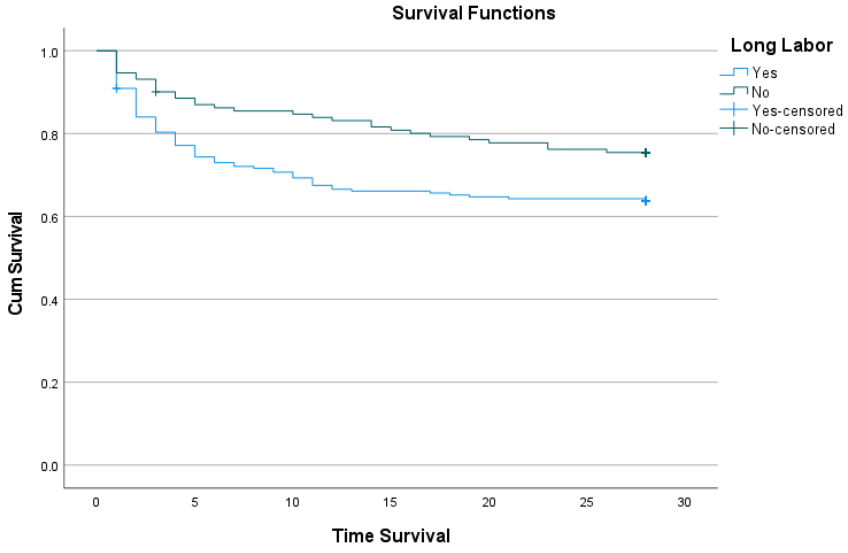


**Figure 4 Survival curve of neonates with asphyxia based on the incidence of prolonged labor**

The results showed that one-third of mothers who took a long time in labor gave birth to neonates with asphyxia with the proportion of neonate survival continuing to decrease along with the length of time of care for neonates.

**d. Early rupture of membranes**

Premature rupture of membranes is included in the variables that will be carried out bivariate analysis based on Kaplan-Meier curves that do not intersect, asphyxia neonates with mothers who experienced premature rupture of membranes had a survival proportion of 82% at the beginning of the study and

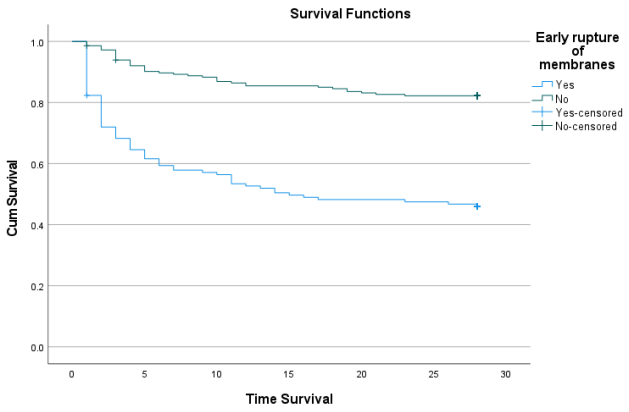


**Figure 5 Survival curve of neonates with asphyxia by incidence of premature rupture of membranes**

### e. Incidence of Antepartum Hemorrhage

The results of the Kaplan-Meier curve did not show the intersection seen in Figure 6 so that bivariate analysis could be performed on the variable of antepartum hemorrhage. The proportion of survival of asphyxia neonates was 59% at the end of observation of neonates born by mothers who experienced antepartum hemorrhage during delivery.

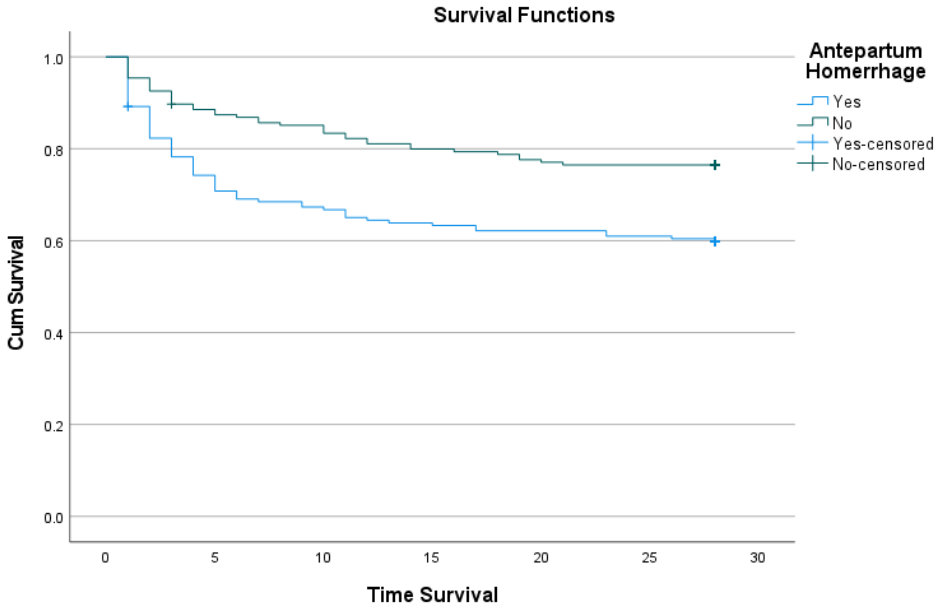


**Figure 6 Survival curve of neonates with asphyxia by incidence of antepartum hemorrhage**

### f. LBW

Neonates with normal weight had a higher survival proportion of 97% at the beginning of observation compared to neonates with low birth weight whose survival proportion was only 79%. To determine the statistically significant effect, bivariate analysis is necessary. Because in Figure 7 there is no intersection between the categories in the *Kaplan-Meier* curve, the LBW variable can be done bivariate analysis.

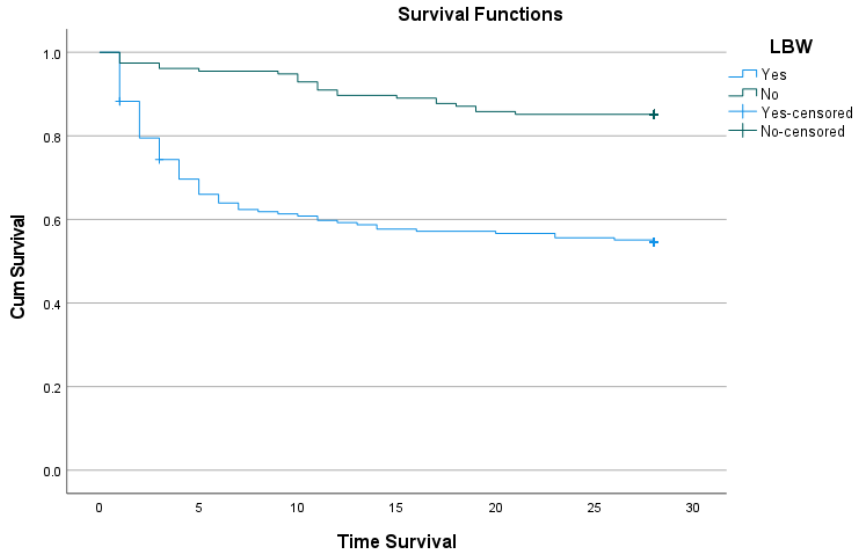


**Figure 7 Survival Proportion Curve of Nenoates with Asphyxia by LBW Incidence**

### g. Premature

The results of the *Kaplan-Meier* curve plot show that there is no intersection between the categories shown in Figure 8, meaning that the preterm variable can be carried out bivariate analysis. For the proportion of survival of asphyxia neonates who experienced preterm birth was 86%, while those who did not experience preterm birth was 97% greater.

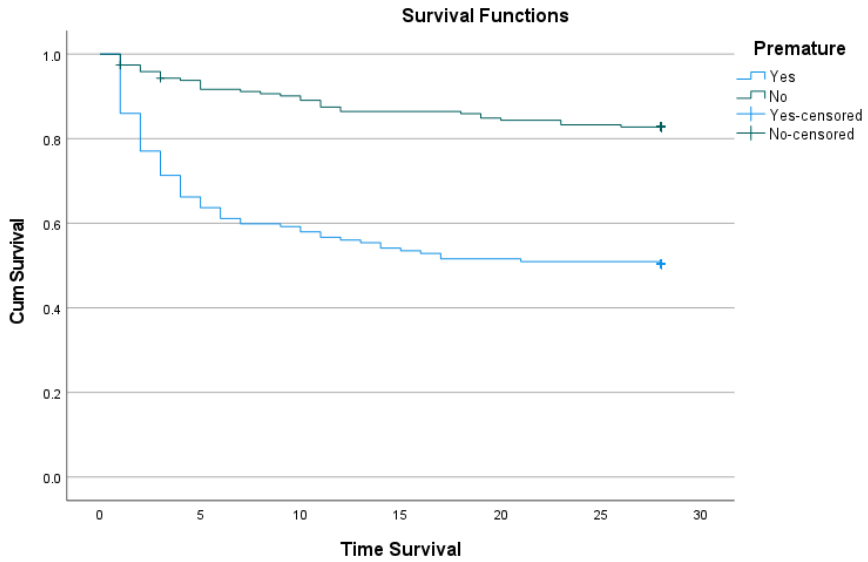


**Figure 8 Survival Proportion Curve of Nenoates with Asphyxia by Premature Events**

### h. Pregnancy Age

Bivariate analysis can be performed on the gestational age variable based on Figure 9 where the Kaplan-Meier curve line does not intersect which means the PH assumption is fulfilled, the proportion of neonate survival based on gestational age is more rendar in mothers who give birth at the gestational age <37 or >42 weeks by 88%.

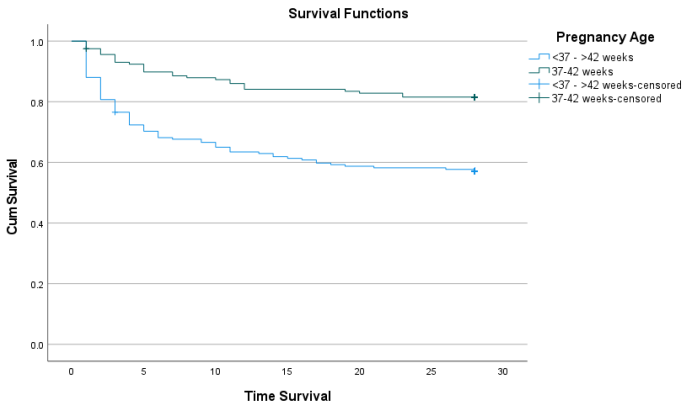


**Figure 9 Proportion curve of survival of neonates with asphyxia by gestational age**

## 5. BIVARIATE COX REGRESSION ANALYSIS

*Bivariate Cox Regression* analysis was used to see the effect of independent variables on the survival of asphyxia neonates and see how much risk (*hazard ratio*). This test can be done if the assumption of PH independent variables, thus all variables are included in the *bivariate Cox regression* analysis. This analysis is also a test conducted to determine whether independent variables can be included in the *multivariate cox regression* analysis that will be carried out which is seen from the p value <0.05(18) . The results of the *bivariate cox regression* analysis on each independent variable are as follows.

**Table 3 Results of bivariate Cox regression analysis of independent variables on survival of neonatal asphyxia neonates in NICU care at Daya Hospital Makassar City 2019-2023**

| Independent Variable | *p Value* | Exp(B) | 95% CI For Exp(B) | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Mother's age | 0,001 | 2,866 | 1,906 | 4,308 |
| Parity | 0,001 | 2,224 | 1,530 | 3,232 |
| Long Labor | 0,019 | 1,635 | 1,084 | 2,465 |
| Early rupture of membranes | 0,001 | 4,020 | 2,712 | 5,959 |
| Antepartum Hemorrhage | 0,001 | 1,937 | 1,317 | 2,849 |
| LBW | 0,001 | 3,868 | 2,441 | 6,128 |
| Premature | 0,001 | 3,702 | 2,461 | 5,569 |
| Pregnancy Age | 0,001 | 2,766 | 1,810 | 4,226 |

In the table of significant values, it is said to be statistically significant if the p-value <0.25, thus it is known that maternal age influences the survival of asphyxia neonates and mothers who give birth at the age of <20 - >35 years are 1.906 times at risk of neonatal death compared to asphyxia neonates born by mothers who give birth at the age of 20-35 years. Then for the parity of asphyxia neonate death, neonates from mothers with primiparous parity were at risk 1.530 compared to multiparous mothers, then neonates born by mothers who experienced prolonged labor, premature rupture of membranes, and antepartum hemorrhage and gave birth at <37 or >42 weeks of gestation respectively had a risk of causing asphyxia neonate death of 1.084, 2.712, 1.317 and 1.810. Whereas for asphyxia neonates who experienced LBW and premature also have a risk of death of 2.441 and 2.461 respectively.

## 6. MULTIVARIATE ANALYSIS

Multivariate analysis is said to be meaningful if the p value is <0.05, variables that can be included in this test are variables that in *bivariate cox regression* analysis have a p value <0.25. After *bivariate cox regression* analysis, it was found that all variables could be analyzed by *multivariate cox regression*, then by using the backward wald method, each variable was

tested and then variables that were not significant were removed from the model until getting the best model. Based on the results of the analysis conducted, the following results were obtained.

**Table 4 Results of *multivariate Cox regression* analysis of independent variables on survival of neonatal asphyxia neonates in NICU care at Daya Hospital Makassar City 2019-2023**

| Independent Variable | B | *p Value* | Exp(B) | 95% CI For Exp(B) | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Mother's age | 0,662 | 0,002 | 1,939 | 1,270 | 2,961 |
| Early rupture of membranes | 0,696 | 0,005 | 2,005 | 1,240 | 3,242 |
| LBW | 0,745 | 0,004 | 2,107 | 1,275 | 3,479 |
| Premature | 0,589 | 0,019 | 1,803 | 1,103 | 2,945 |

The results of *multivariate Cox regression* analysis showed that the *p* value <0.05 is the variable that influences the survival of asphyxia neonates, namely maternal age, premature rupture of membranes, LBW and prematurity. To determine the order of variable strength affecting the incidence of asphyxia neonate death, it is seen from the largest *hazar ratio*. Then the LBW variable becomes the most dominant variable causing neonatal asphyxia neonatal death in the survival of neonates with asphyxia, asphyxia neonates who have low birth weight have a probability of experiencing neonatal death of 2.030 times compared to asphyxia neonates with normal birth weight. Furthermore, to make the survival equation, the coefficient value is needed which is taken from the B value and the baseline hazard and baseline survival values. The equation obtained is assumed to calculate the *hazard of* asphyxia neonates who experience LBW and born prematurely, from mothers who give birth at the age of <20 - >35 years and experience premature rupture of membranes, and want to know the survival probability of asphyxia neonates with normal birth weight who are born by mothers with the age of 20 - 35 years who do not experience premature rupture of membranes respectively on day 7. From the equation, it is found that the hazard on day 7 that will be experienced is 0.3028. This means that neonates who experience this condition have a probability of neonatal death of 30.28%. Then the survival result at day 7 is 0.820. This means that neonates with these conditions have a probability of survival of 82%.

## 7. DISCUSSION

The results showed that more asphyxia neonates were born by mothers aged <20 or >35 years (high risk category) compared to mothers aged 20-35 years (low risk category), where 40.16% of neonates who experienced death (*event*) were born by mothers with high risk age. This shows that the proportion of survival of asphyxia neonates is higher in mothers aged 20-35 years. This finding is in line with Ekasari's study which showed a significant effect of maternal age on the incidence and survival of asphyxia neonates(19) , but in contrast to Getaneh who stated that maternal age is not a factor affecting neonate survival(20) . Medically, pregnancy at the age of <20 years is risky because the uterus is physiologically immature and prone to complications such as anemia, while age >35 years increases the risk of degenerative diseases and stiffness of the birth canal which can complicate the delivery process.

Statistically, parity affects the incidence of neonatal asphyxia in neonates but does not directly affect the survival of neonates. Similar results were also obtained in a study conducted by(21) where between parity and neonate survival there was no direct influence causing neonate death with asphyxia. In contrast to the results obtained by the researcher, research conducted by(22) showed that there was an influence between parity with the incidence of asphyxia and the survival of neonates with asphyxia.

*Bivariate cox regression* analysis on prolonged labor on neonate survival with asphyxia shows that prolonged labor has a significant effect on the incidence of asphyxia neonate, but on the other hand in multivariate analysis the test results are inconsistent and show that prolonged labor has no direct effect on neonate survival. in line with the results of research conducted in Ethiopia in 2022(20) which statistically prolonged labor has no effect on neonate survival. However, in other countries(3) showed the results that there was a statistical influence between prolonged labor and the survival of asphyxia neonates. The results showed that most neonates with asphyxia were born due to premature rupture of membranes with the proportion of survival decreasing day by day during the neonatal period. The influence between premature rupture of membranes and survival of neonates with neonatal asphyxia was statistically significant in *bivariate*, and *multivariate Cox regression* analysis of neonatal asphyxia neonates who were born due to premature rupture of membranes had a risk of 1.804 death. This result is in line with the research conducted by(13) which shows the effect of premature rupture of membranes significantly on the survival of asphyxia neonates. In contrast to this, research conducted by(23) did not find a statistically significant effect.

The results showed the proportion of neonate survival with asphyxia decreased in line with the increasing number of days of care, antepartum hemorrhage affected neonate survival based on bivariate analysis but had no effect based on multivariate analysis. This study is in line with the research conducted by(24) in ethophia which also did not get a statistically significant difference between mothers who experienced antepartum hemorrhage and those who did not experience antepartum hemorrhage. But not in line with the research conducted by(25) where the results showed that antemartum hemorrhage is a causative factor that can cause the incidence of neonatal asphyxia in neonates who are born.

The results showed that most of neonates with asphyxia had low birth weight significantly LBW influenced the survival of asphyxia neonates, with a risk of 2.030 meaning that neonates with asphyxia 2.030 experienced death if they also experienced LBW. However, after multivariate analysis, LBW no longer statistically influenced the survival of asphyxia neonates after being tested together with the variables of maternal age and premature rupture of membranes because these two variables were more dominant than the variable of LBW. Research that is in line with this is a study conducted by(26) with the same results as those found by researchers where there is a significant influence between the incidence of LBW and neonatal asphyxia neonates, while the research conducted by(25) obtained results that are not in line with the results of this study where LBW does not significantly affect the survival of neonates with neonatal asphyxia.

*Bivariate Cox regression* analysis showed that there was a statistically significant influence between the incidence of prematurity in neonates and the survival of neonates who experienced neonatal asphyxia. In contrast to this, the multivariate analysis showed that prematurity in infants no longer influenced the survival of neonates with neonatal asphyxia. Similar research was conducted by(27) where prematurity was not included in the factors influencing the incidence of asphyxia and survival of neonates with asphyxia. While research with different results was conducted by(28) with the results where prematurity is a factor in the occurrence of asphyxia and affects the survival of neonates with asphyxia neonatrum.

Gestational age affects neonate survival statistically, but is not a direct factor causing neonate mortality in asphyxia neonates. This study is in line with the research conducted by(27) because in his research it was found that there was no significant effect of gestational age on the survival of asphyxia neonates. Gestational age between <37 or >42 weeks increases the risk of neonatal asphyxia and affects neonate survival. At the age of <37 weeks the fetus is not ready to be born while at the gestational age of >42 weeks the fetus is too old, the amniotic fluid decreases so that it can inhibit the process of transferring oxygen from mother to fetus through the umbilical cord.

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