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# Risk Factors Influencing the Incidence of Low Birth Weight Infants at Wangaya Regional General Hospital, Denpasar City, Bali

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## ABSTRACT

**Background**. One of the main indicators of a child's health status is the infant mortality rate. Indonesia ranks among the top 10 nations with the highest mortality rate for children under the age of 5. Every year, 72% of toddlers and infants died, and low birth weight (LBW) stands out as a significant contributing factor. The mortality rate for LBW infant is 20-35 times greater than that of infants with normal birth weight.

**Methods**. This research uses a cross-sectional analytic observational study which was done in January 2023 at Wangaya Regional Hospital in Bali, Indonesia. Research subject were all of the newborns at Wangaya Hospital. Inclusion criteria including subject must be hospitalized in NICU, PICU, or Mother-Infant unit between September and December 2022. Sampling method used was total sampling. Bivariate analysis was done using chi squared test, and multivariate analysis was done using logistic regression test.

**Result**. Amongst 317 samples taken, the proportion of LBW infants is 13.2%. Risk factors which lead to LBW including presence of antenatal care visit (p= 0.021), number of parities (p= 0.012), and maternal anemia (p= 0.026). It was also identified that mothers who did not undergo any antenatal care are at a higher risk of giving birth to a LBW infant (p= 0.024, OR 5.128 (95% CI 1.242 - 21.169).

**Conclusion**. The risk of LBW can be reduced by pregnant mother doing regular antenatal care visits, taking blood supplement and foods that can increase hemoglobin level and limiting the number of pregnancies.

***Keywords:*** Low Birth Weight, Risk Factors, Antenatal Care, Anemia, Number of parities

## INTRODUCTION

A child's birthplace holds a significant impact on their chances of surviving. With 56 deaths every 1000 live births, Indonesia is ranked seventh among the nations with the highest newborn mortality rates in 2020, behind Ethiopia, the Democratic Republic of the Congo, India, Nigeria, and Pakistan. Because low birth weight (LBW) infants are the primary source of illness and death throughout the newborn period, LBW infants continue to be an issue globally.[1]

According to the data released by WHO in 2004, more than 20 million infants were born with LBW with 95.6% of them were born in developing countries. LBW is accounted to have prevalence of 15.5% of all births with 20-35 times higher mortality rate than normal birth infants (NBW). LBW incidence in Indonesia varies greatly according to the region where the infant was born, ranging from 9% to 30%.[2]

The average newborns usually weigh around 3500 grams, and newborns with less than 2500 grams of birth weight, regardless of their gestational age, are said to be LBW. Birth weight is measured within the first hour after an infant was born, or 24 hours after birth for infants that were born at home.[2] Infants with LBW usually is born healthy even though they have small bodies, but they also have 20 folds higher risk of

dying than infants compared with NBW. LBW is associated with decreased child growth and development, reduced intelligent quotient (IQ), higer mortality and morbidity rates.[3,4]

Risk factors for LBW are divided into maternal, fetal and placental factors Maternal factors that contributes to a LBW infants including history of previous LBW births, low socioeconomic status, low level of maternal education, no antenatal care during pregnancy, maternal age under 20 years or above 35 years, short interval between pregnancies, exposure to cigarette smoke, alcohol and drugs use, physical stress (standing or walking for extend period), psychological problems (poor social support), low weight before pregnancy (<45 kg), low weight gain during pregnancy (<4.5 kg), and Afro-American race. Pregnant women who suffered chronic energy malnutrition and poor nutritional status alos have a higher risk of giving birth to LBW infants.[4]

The incidence of LBW is higher in mothers under the age of 20 years or over the age of 35 years. This happens because the uterus hasn't gain enough strength to support a pregnancy. When a woman is between 20 and 35 years old, she is in the prime of her fertile years and is more likely to conceive a healthy child. After puberty, a woman's body takes several cycles to begin producing an well suited environment for an infant to grow. Young mothers, sometimes as young as 13 years old, have a much greater frequency of giving birth to infants with low birth weight compared to older ages. The opposite process to puberty is menopause. Menopause usually occurs around the age of 45-55. Menopause changes the levels of hormones needed to maintain the ideal uterine environment. Because of this, older women might have a higher chance of giving birth to infants with low birth weight. [5,6]

Maternal parity is a well-recognized predictor of infant birth weight, with the lowest birth weight observed in infants born with nulliparous mother. This is caused by physiological changes that occurs during pregnancy. Uteroplacental blood flow, which is responsible for delivering oxygen and nutrients to the fetus, is greater in subsequent pregnancies, compared with the nulligravid uterus. Mothers with first parity are considered to be lacking in maternal experience and knowledge in managing their pregnancy. [3,7]

The possibility of LBW is greater in mothers with parity >4. This happened because of the presence of scar tissue due in the uterus due to previous pregnancies and childbirth. This scar tissue results in inadequate blood supply to the placenta making placental attachment of the placenta imperfect, thus making the placenta thinner and covers wider part of the uterus. This imperfection also cause disruption of the distribution of nutrients from the mother to the fetus, making it insufficient to meet the fetus's needs. [3]

Quality of antenatal care (ANC) will affect the health status of pregnant women and their infants. ANC service for pregnant women includes delivery services, postpartum maternal health services, and newborn health services. ANC evaluates maternal nutritional status, screening for maternal risk factors, and emotional support. LBW case is shown higher in women who do not receive antenatal care in their pregnancy.[3,4] Research has found that after adjusting for other differences such as socioeconomic status and maternal age, infants born to mothers who receive no ANC suffer from LBW. For example, early ANC among white adolescents showed a 27 percent reduction in low birth weight births. [6]

Anemia is the most common hematological disorder in pregnancy. The incidence of anemia in pregnancy is as high as 40%. Maternal anemia is also responsible for 20% of maternal deaths in developing countries.[8] According to WHO, anemia in pregnancy is defined as hemoglobin concentration under 11 g/dl or a hematocrit level of under 33%.[9] Anemia in the third trimester pregnancy is associated with

adverse effects on neonatal outcomes such as fetal anemia, stillbirth, neonatal death, and LBW. [10]

Level of education can be divided into two categories: high-education and low-education. Higher education level includes junior high school, high school, diploma and bachelor's degree, while low education levels include elementary school and no formal education. Mothers with a higher level of education are twice as likely to have more ANC, greater sense of responsibility, more knowledge about what they should do, and better judgment when making decisions about their health. Several studies conducted in various countries show that education is the strongest socio-economic predictor of health status and the most important determinant of birth weight in a population. [3,10]

HIV-infected women have a higher risk of having low birth weight infants or infants born prematurely compared to uninfected women. These associations did not change significantly over time or were not significantly affected by the use of antiretroviral drugs. [11]

Fetal factors can be either asymmetric Intra-Uterine Growth Restriction (IUGR), characterized by manifestations of malnutrition, or symmetric IUGR, known as hypoplastic small for dates, or a combination of both (mixed IUGR). Asymmetric IUGR, comprising 70-80% of cases, typically arises from late pregnancy abnormalities, often linked to utero-placental insufficiency. This type results in infants with normal length and head circumference but lower weight, a phenomenon known as brain sparing. Conversely, symmetrical IUGR stems from early pregnancy abnormalities, such as genetic, structural, or infectious issues, causing reduced anthropometric parameters across weight, length, and head circumference. [12]

Insufficient blood flow due to an abnormal placental attachment, abberant placental vascularization, maternal hypertensive conditions, and exposure to cigarette smoke are all factors contributing to IUGR.[12] The histopathological indicators of placental insufficiency include chorionic villous fibrosis, uteroplacental thrombosis, placental infarction, fibrin deposits, or a decrease in both the number and surface area of villous capillary trees. [13]

Hence, understanding the risk factors that impact the occurrence of LBW infants is crucial. This knowledge enables us to enhance prevention strategies and recommendations, ultimately reducing the prevalence of LBW

## MATERIALS & METHODS

This study adopts a cross-sectional analytic design. The selection of participants involved extracting data from the register book and medical records of newborns who were born at Wangaya Regional Hospital and subsequently admitted to the Neonatal Intensive Care Unit (NICU), Perinatology, and Mother-infant unit at Wangaya Regional Hospital in Denpasar during the period from September 2022 to December 2022.

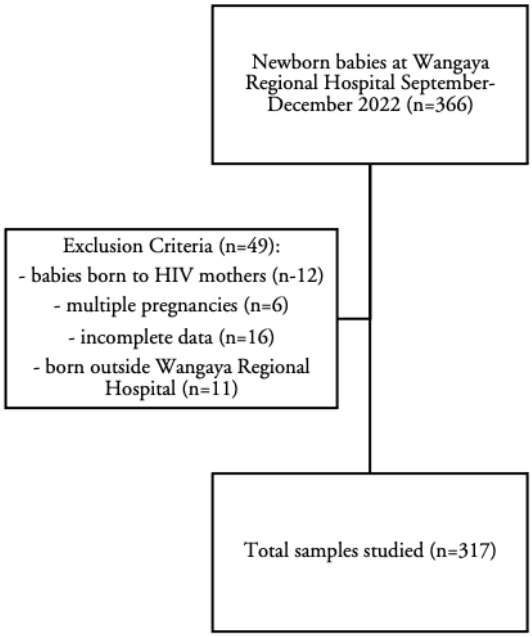
The criteria for inclusion comprised newborns delivered at Wangaya Regional Hospital and receiving care in the Neonatal Intensive Care Unit (NICU), Perinatology, and the mother-infant unit during the timeframe of September 2022 to December 2022. Excluded from the study were infant patients with incomplete medical record data, those born outside Wangaya Regional Hospital, and mothers affected by HIV infection or experiencing twin pregnancies.

Ethical approval for this study was granted by the Ethics Commission of Wangaya Hospital in Denpasar. Information was gathered from medical records, encompassing details such as gender, birth weight, delivery method, history of antenatal care (ANC), parity count, maternal age at delivery, maternal anemia, and maternal education level.

All information was extracted from the patient registry and medical records, after which the gathered data underwent coding through the Microsoft Excel program to

maintain patient confidentiality. Subsequently, the data was subjected to analysis utilizing SPSS version 25, employing the Chi-square test for bivariate analysis and Fisher's Exact Test for multivariate analysis. The significance level in this study is indicated by $p<0.05$.

## RESULT




**Picture 1. Research Sample Illustration**

From 317 samples. There were 188 infants (59.3%) male and 129 infants (40.7%) female. In this study birth weight was divided into low birth weight as many as 42 infants (13.2%) and normal birth weight as many as 275 (86.8%). The sample characteristics of this study are listed in Table 1.

**Table 1. Research Characteristics**

| Characteristics | Frequency (n) | % |
|---|---|---|
| Gender | | |
| Man | 188 | 59.3 |
| Female | 129 | 40.7 |
| Birth Weight | | |
| Low Birth Weight (LBW) | 42 | 13.2 |
| Normal Birth Weight (NBW) | 275 | 86.8 |
| Mode of Delivery | | |
| Caesarean Section | 135 | 42.6 |
| Vaginal | 182 | 57.4 |
| ANC History | | |
| No | 9 | 2.8 |
| Yes | 308 | 97.2 |
| Number of Parity | | |
| Risky | 118 | 37.2 |
| Not Risky | 199 | 62.8 |
| Mother's Age | | |
| Risky | 58 | 18.3 |
| Not Risky | 259 | 81.7 |
| Maternal Anemia | | |
| Yes | 124 | 39.1 |
| No | 193 | 60.9 |
| Level of Education | | |
| Low | 35 | 11.0 |
| High | 282 | 89.0 |

**Table 2. Cross Tabulation Results**

| Characteristic | Low Birth Weight (LBW) (n=42) | | Normal Birth Weight (NBW) (n=275) | | p-value | OR (95% CI) |
|---|---|---|---|---|---|---|
| | N | % | N | % | | |
| ANC History | | | | | | |
| No | 4 | 44.4 | 5 | 55.6 | 0.021* | 5.684 (1.462 – 22.101) |
| Yes | 38 | 12.3 | 270 | 87.7 | | |
| Number of Parity | | | | | | |
| Risky | 23 | 19.5 | 95 | 80.5 | 0.012† | 2.294 (1.190-4.422) |
| No Risky | 19 | 9.5 | 180 | 90.5 | | |
| Mother's Age | | | | | | |
| Risky | 9 | 15.5 | 49 | 84.5 | 0.573† | |
| No Risky | 33 | 12.7 | 226 | 87.3 | | |
| Maternal Anemia | | | | | | |
| Yes | 23 | 18.5 | 101 | 81.5 | 0.026† | 2.085 (1.083-4.016) |
| No | 19 | 9.8 | 174 | 90.2 | | |
| Level of Education | | | | | | |
| Low | 4 | 11.4 | 31 | 88.6 | 1.000* | |
| High | 38 | 13.5 | 244 | 86.5 | | |

†Cross tabulation test using the Chi-Square method
*Cross tabulation test using the Fisher's Exact Test method

Based on the results of the cross-tabulation analysis, there were 9 children with LBW and maternal age at risk (21.4%) and 33 children with LBW and maternal age not risky (78.6%), with a p-value of 0.573. This states that the mother's age is not a risk factor for the incidence of LBW in infants born at Wangaya Regional Hospital, Denpasar.

Meanwhile, other cross tabulation test results showed that maternal anemia (p-value 0.026), mothers with no ANC history (p-value 0.021), risky number of parity (p-value 0.012) were at risk of LBW infants.

**Table 3. Multivariate Regression Results**

| Variable | p-value | OR (95%CI) |
|---|---|---|
| ANC History | 0.024 | 5.128 (1.242 – 21.169) |
| Number of Parity | 0.015 | 2.312 (1.174 – 4.556) |
| Maternal Anemia | 0.014 | 2.342 (1.188– 4.616) |

Meanwhile, from the results of the multivariate regression, it was found that infants whose mothers did not have ANC had a significant impact on the occurrence of LBW with an OR of 5.128 (95% CI 1.242-21.169). Maternal anemia [OR 2.342 (95% CI 1.188-4.616] and risky number of parities are also a risk factor for LBW [OR 2.312 (95% CI 1174-4556)].

## DISCUSSION

This study found that maternal age (p-value 0.573) and maternal education level (p-value 1.000) were not risk factors for LBW at Wangaya Hospital, Denpasar. It is different from research conducted by Sandra and Trisna at the Gianyar II Bali Community Health Center in 2015 that found the mother's age (p-value 0.000, OR 36.111, 95%IK 9.261-140.809) and the mother's education level (p-value 0.000, OR 19,190, 95% CI 2,469-149,146) is a risk factor for LBW. [3] However, it is similar with the research conducted by Mahayana et al at RSUP Dr. M Djamil Padang in 2016, namely that there was no significant relationship between maternal age (p value = 0.573) and education level (p value = 1,000) with the incidence of LBW. [14] Research conducted by Deshpande et al in 2011 in India also found that there was no significant relationship between maternal age and the incidence of LBW with a value of p=0.09. [15] In research conducted at RSKIA Bandung City in 2019 by Damayanti et al, a non-significant relationship was found between LBW and maternal age (p value=0.373). Differences in the results can occur because the mother's age and the mother's education level are not only the main risk factors for the occurrence of LBW. The mother's biological condition can be influenced by factors in her daily activities such as fluctuating hormonal conditions and the mother's health condition. [16]

In this study, the mother's education level was not a risk factor for LBW. Based on

previous research, several studies found a significant relationship between education level and the incidence of LBW, but there were some that did not find a significant relationship. In principle, the occurrence of low birth weight (LBW) is believed to be significantly affected by the maternal knowledge factor. In this research, the formal education level serves as an indicator of maternal knowledge. Nevertheless, it is revealed that a substantial formal education does not consistently signify the mother's understanding of pregnancy and delivery. The level of awareness regarding pregnancy and childbirth appears to be more contingent on the extent of interaction the mother has with healthcare professionals.

In this study, mothers who did not receive ANC services during pregnancy had a 5.6 times greater risk of experiencing LBW (p-value = 0.021, OR 5.684, 95%CI 1.462–22.101) compared to mothers who received ANC services during pregnancy. This is in accordance with research conducted by Sandra and Trisna which states that there is a significant relationship between the number of risky antenatal visits and the incidence of LBW. (p-value = 0.000, OR 52.111, 95%CI 6.417–423.181). [3] ANC services aim to monitor maternal health and fetal development, as well as detect abnormalities in pregnancy and childbirth, and plan a healthy birth so as to prevent maternal and infant deaths. [5]

Enhancing antenatal care (ANC) services involves improvements not only in coverage but also in the frequency and quality of the provided care. According to the latest guidelines from the World Health Organization (WHO), it is advised to increase the minimum number of ANC visits during pregnancy from the previous four to at least eight times. Indonesia has adopted this approach, setting a minimum of six ANC visits, distributed as one in the first trimester, two in the second trimester, and three in the third trimester. To meet established standards, ANC services should implement the 10T components, including assessing the mother's weight, blood pressure, uterine fundus height, tetanus immunization, iron supplementation, routine laboratory tests, nutritional status, prevention of mother-to-child transmission (PMTCT), counseling, and referral management. Additionally, it is recommended to conduct an ultrasound examination before 24 weeks and have at least two ANC visits with a doctor to identify non-obstetric comorbidities such as heart disease, tuberculosis, autoimmune diseases, HIV, and diabetes mellitus, which could complicate pregnancy and childbirth. [5]

A limitation of this study was that there were only 9 infants (2.83%) whose mothers had no history of ANC. This is due to limited data on ANC history in mothers which can only be classified into yes and no, even though in 2022, the Ministry of Health has stipulated that ANC services be carried out at least 6 times during pregnancy.[5]

This research shows that pregnant women who have a parity number of 1 or >4 have a 2.3 times greater risk of giving birth to LBW compared to pregnant women who have a parity number of 2-4. This is similar with the research conducted by Fitri Sondari in 2006 at Hasan Sadikin Hospital in Bandung and Sandra and Trisna at Gianyar II Public Health in 2015 which stated that there was a relationship between the number of parities and the incidence of LBW with a value of p=0.000. [3,17] This is because at a parity number > 4, there is scar tissue due to previous pregnancy and childbirth. Scar tissue results in insufficiency of blood flow to the placenta so that the attachment of the placenta is imperfect, it becomes thinner, so that the distribution of nutrients from the mother to the fetus is obstructed. [3,18] According to the Wiknjosastro Theory in 2016, it is stated that primiparous pregnant women have not been able to adapt to their pregnancy so they have a risk occurrence of LBW. This happens because at first parity the mother still lacks the experience and knowledge of pregnant women in handling their pregnancy, so that it can have an

impact on the mother's lack of maintaining the nutritional status of the mother and fetus in the womb, so that it can have an impact on the birth weight of the infant being born. [19]

In this study, the results also showed that mothers with anemia had a 2 times greater risk of giving birth to LBW infants (p-value = 0.026, OR 2.085, 95% CI 1.083 – 4.016) compared to mothers who were not anemic. Anemia is defined when the Hb level is <11 g/dL. Anemia in pregnant women increases the risk of LBW due to disruption of oxygen flow and uteroplacental nutrition. Reduced blood flow to the uterus causes the fetus to experience hypoxia. Hypoxia will result in oxidative stress, namely an imbalance between the amount of free radicals and the amount of antioxidants, which results in disruption of optimal growth and development of the intrauterine fetus. This is in line with research conducted by Allen et al in 2007 which found that mothers with anemia in early pregnancy had a 1.75 times higher risk of giving birth to premature and LBW infants. Therefore, pregnant women are advised to consume foods that can increase hemoglobin in the blood, and additional iron supplements to increase the number of red blood cells. [3,4,8,20]

This study's limitations stem from its utilization of a cross-sectional research method and reliance on secondary data, introducing a notable bias due to the retrospective nature of the research and reliance on anamnesis recorded in medical records. Consequently, there is a need for further investigation employing primary data to explore low birth weight (LBW) risk factors. Moreover, the use of formal education as an indicator for maternal knowledge is a limitation, as a mother's formal education may not necessarily align with her understanding of pregnancy and childbirth. Formal education typically imparts general knowledge, while specific knowledge relevant to pregnancy and childbirth requires a distinct focus. Additionally, the study's scope is confined to a single Regional General Hospital in Denpasar, limiting the generalizability of the findings to areas beyond Denpasar, particularly in non-urban settings.

## CONCLUSION

The incidence of LBW in 317 infants born at Wangaya Regional Hospital was 42 infants with a proportion of 13.2%. The risk factor for LBW that plays the most role in infants born at Wangaya Regional Hospital is mothers who do not receive ANC services. Maternal age and maternal education level are not risk factors for LBW at Wangaya Regional Hospital, Denpasar. Other risk factors that can influence the occurrence of LBW are the number of parities and anemia in the mother.

### *Declaration by Authors*

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