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CORRELATION BETWEEN HEMOGLOBIN LEVEL AND LOW BIRTH WEIGHT AMONG PREGNANT WOMEN IN MANOKWARI, WEST PAPUA

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Abstract

Introduction: Birth weight and its related maternal factors have significantly affected health throughout an individual's life, particularly in western Indonesia. This study aims to reveal the effect of maternal anemia on low birth weight among newborns in General Hospital.

Methods: A formative study was conducted from October to December 2023 in Manokwari, West Papua Province, Indonesia. We used secondary data from the birth cohort register 2022, including maternal socio-demographic information, health-related factors, antenatal visit details, and neonatal birth outcomes.

Results: Pregnant women who give birth have an average gestational age of 28.80 (±1.08). The average hemoglobin level among pregnant women is 10.25 (±2.12), and the average newborn birth weight is 2932.9 (±447.1). Maternal age, educational status, employment status, infant gender, gestational age, and comorbidities do not correlate with birth weight. In contrast, hemoglobin levels with birth weight have a significant relationship between maternal hemoglobin levels and newborn birth weight.

Conclusion: The study revealed that mothers with low hemoglobin levels are significantly associated with low birth weight among newborns at Manokwari Regional Hospital, West Papua. Future studies should be adjusted to explain pregnant women's iron levels and nutrition intake.

Keywords: maternal anemia, hemoglobin, low birth weight, formative study

Introduction

Anemia in pregnancy is a condition of pregnant women with hemoglobin levels below 11 gr/dl.[1] Worldwide, around 15% of pregnant women with anemia occur in developing countries,

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while in Indonesia, pregnant women with anemia are 48.9%.[2] A pregnant woman with anemia can decrease the blood's ability to bind and carry oxygen, and the nutrients carried by red blood cells will also decrease. Anemia during pregnancy has been widely investigated to examine its impact on maternal and fetal outcomes.[3,4] Previous studies reported that severe anemia during pregnancy could have significant adverse effects on the mother and the baby, such as fetal anemia, stillbirth, and low and very low birth weight (LBW).[4,5]A study conducted in Nepal showed that the risk of LBW was 6.8 times higher among.[5]

World Health Organization reported that the number of low birth weights in Asian countries was 30 million.[1] Indonesia is one of the middle and low-income countries in Asia that has been struggling with the burden of newborn child mortality due to low birth weight. The percentage of newborn deaths due to low birth weight is 34,5 %.[2] This number is different between the provinces in Indonesia. West Papua province has high numbers of LBW in Indonesia, with a percentage of 14.51%. That placed West Papua in the ten provinces with the most LBW cases.[6] Maternal nutrition deficiency status might affect the development of the fetus and subsequently influence the birth weight of the newborn infant. An inadequate nutrition intake can have adverse effects on mothers and newborn children. Indonesia has a significant infant mortality rate due to low birth weight (LBW). In 2018, West Papua had a 6.2% LBW of the total birth rate.[5,7] Therefore, this study aimed to assess the effect of maternal anemia on low birth weight among newborns in General Hospital, Manokwari, Papua, Indonesia.

Methods

This formative study was used to analyze the secondary data. We collected secondary data from the information on the pregnant woman, consisting of hemoglobin levels and birth weight, from the General Hospital Manokwari, Papua, Indonesia. Manokwari was located in West Papua Province.

Study Design and Setting

This study applied a preliminary approach to obtain baseline data on potential causality between hemoglobin levels and low birth weight. Its detailed design and methods obtained ethical approval from Catholic Soegijapranata University (Number 0002/B.72/UN.KEEP/09/2023). The study was conducted in Manokwari, Papua, Indonesia.

Population and Sampling

This study used data from the birth cohort report 2022 from General Hospital. The sampling technique used was total sampling, with 104 participants with a full-term pregnancy period.

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Mothers without syphilis, hepatitis B, and HIV/AIDS were included, and mothers with bleeding during antepartum and with BMI < 18,5 during giving birth were excluded.

Variable and Measurement

Hemoglobin measurement was conducted by trained clinical laboratory staff during antenatal visits at the District Hospital. Maternal hemoglobin levels <11 gr/dl were diagnosed as gestational anemia, according to the World Health Organization (WHO).[1] We categorized birth weight as normal weight and low birth weight. The normal weight of the newborn's birth weight was ≥ 2500 grams.[7] This study also involved sociodemographic factors such as mothers' age, education status, occupation status, sex of newborn, and gestational age.

Data Analysis

All the secondary data was analyzed using univariate and bivariate methods. The results of univariate analysis were presented using proportion for categorical data and mean (SD) for numerical data. We applied an independent T-test, Mann-Whiteney, and Chi-square, with CI 95%, and it was significant if the p-value < .05.

Results

All 108 subjects who participated in the study were pregnant women who met the inclusion and exclusion criteria. The participants included newborns with both normal and low birth weights. Table 1 presents the distribution of the patient's characteristics.

Table 1. Respondent Characteristics

Variable	Frequency	%	Mean ± SD	Median (min-max)
Age			27,04 ± 5,56	26 (17 – 46)
Education Status				
Primary School	4	3,7		
Junior High School	15	13,9		
Senior High School	62	57,4		
Diploma	9	8,3		
Undergraduate	18	16,7		
Occupation Status				
Housewife	87	80,6		
Civil servant	4	3,7		
Contract employee	7	6,5		
Teacher	3	2,8		
Others	7	6,5		
Sex of Newborn				
Male	42	42,9		
Female	56	57,1		
Gestation Age			38,80 ± 1,08	39 (37 – 41)

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Variable	Frequency	%	Mean ± SD	Median (min-max)
Hemoglobin level			10,25 ± 2,12	10,5 (5,2 – 17,6)
Birth Weight			2932,9 ± 447,1	2925 (1800 – 4300)
Low	17	15,7		
Normal	91	84,3		
Underlying Diseases				
Yes	46	42,6		
No	62	57,4		

Table 1 shows the age range of mothers giving birth at Manokwari Regional Hospital is 17 - 46 years. The most education is junior high school. The most common occupation is housewife. The gender of the baby born is primarily female. Pregnant women who give birth at Manokwari Regional Hospital have an average gestational age of 28.80 ± 1.08. The average hemoglobin level in pregnant women is 10.25 ± 2.12, and the average weight of newborns is 2932.9 ± 447.1, where most do not have comorbidities.

Table 2. Correlation analysis of factors associated with low birth weight among newborns in Manokwari, West Papua

Variable	Birth Weight		p-Value
	Low	Normal	
Age	26,41 ± 5,82	27,15 ± 5,53	0,616§
Education Status			
Primary School	1 (5,9%)	3 (3,3%)	0,575‡
Junior High School	2 (11,8%)	13 (14,3%)	
Senior High School	11 (64,7%)	51 (56%)	
Diploma	1 (5,9%)	8 (8,8%)	
Undergraduate	2 (11,8%)	16 (17,6%)	
Occupation Status			
Housewife	13 (76,5%)	74 (81,3%)	0,739¥
Civil Servant	1 (5,9%)	3 (3,3%)	
Contract employee	2 (11,8%)	5 (5,5%)	
Teacher	1 (5,9%)	2 (2,2%)	
Others	0 (0%)	7 (7,7%)	
Sex of Newborn			
Male	6 (35,3%)	36 (44,4%)	0,672¥
Female	11 (64,7%)	45 (55,6%)	
Gestation age	38,47 ± 1,18	38,86 ± 1,06	0,209‡
Underlying Diseases			
Yes	7 (41,2%)	39 (42,9%)	1,000¥
No	10 (58,8%)	52 (57,1%)	
Hemoglobin level	7,80 ± 1,72	10,70 ± 1,87	<0,001‡*

Keterangan :* Signifikan (p < 0,05); § Independent-t; ‡ Mann-Whitney; ¥ Chi-Square

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Table 2 shows maternal age, educational status, employment status, infant gender, gestational age, and comorbidities do not correlate with birth weight. In contrast, hemoglobin levels with birth weight have a p-value <0.001, indicating a significant relationship between hemoglobin levels and birth weight at Manokwari Regional Hospital, West Papua.

Discussion

The study showed that maternal age, education, occupation, baby's sex, gestational age, and comorbidities such as oligohydramnios, premature rupture of membranes, and low-lying placenta were not related to the low birth weight and standard birth weight groups. Hemoglobin (Hb) levels were significantly related between low and average birth weight groups. The birth weight of babies at Manokwari Hospital was mainly in the normal category, namely ≥ 2500 grams, as many as 91 people or 84.3%. Birth weight is influenced by several factors, namely maternal factors such as maternal physiology, chronic diseases during pregnancy, twin pregnancies, maternal body mass index, placental factors such as placenta previa abnormalities, and fetal factors, namely genetic abnormalities and infections in the fetus during pregnancy.[8,9]

Pregnant women who gave birth to low birth weight babies at Manokwari Regional Hospital had lower hemoglobin levels than normal birth weight and an average hemoglobin level, which is included in the low category (<11gr/dl). This follows research conducted by Lumbanraja (2019), which stated that 50% of pregnant women in Southeast Asia experience anemia. A previous study by Davidson revealed that anemia during pregnancy is most often caused by a lack of consumption of nutrients, especially iron.[11] According to Nugraha in his research, during pregnancy, there will be an increase in plasma volume. Hemodilution occurs due to an imbalance between increased plasma volume and erythrocyte production. Therefore, iron consumption during pregnancy is essential for the formation of hemoglobin.[12]

The study showed a relationship between hemoglobin levels in mothers giving birth and birth weight at Manokwari Regional Hospital, West Papua. This can be seen from the results of the bivariate test using Mann-Whitney. Mothers with low hemoglobin levels are 7.6 times at risk of giving birth to babies with LBW.[13] Lack of hemoglobin during pregnancy can cause anemia in the mother.[13,14] If hemoglobin levels decrease, the blood's ability to bind and carry oxygen will decrease. Aerobic tissue in the human body requires oxygen as a material for pyruvate metabolism into acetyl-CoA, which can enter the citric acid cycle to form ATP in the

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metabolism of the mother and fetus. Therefore, in pregnant women, low hemoglobin will cause the fetus to lack oxygen supply so that it experiences growth disorders.[14]

This study's results align with Khan's study, indicating that anemia in pregnant women is a risk factor for low birth weight babies. Mothers with hemoglobin values <11 gr/dl have a 3.31 times higher risk of giving birth to babies with LBW compared to pregnant women with hemoglobin values ≥ 11 gr/dl.[15] Based on the results of the study, it was found that 100% of babies with LBW were born from groups of mothers with low hemoglobin. Oxygen transfer from the mother to the fetus is limited by blood flow through the placenta; the estimated rate of uteroplacental blood flow is 8 mL/minute/kg fetal weight because the oxygen reserves in the fetal blood are only sufficient for 1-2 minutes, the oxygen supply must continue. Therefore, in conditions of hemoglobin deficiency, it will affect the oxygen supply. This interferes with fetal growth and development and poses a risk of low birth weight. Hemoglobin also carries metabolic waste in the form of carbon dioxide from the fetus to the mother. When hemoglobin levels decrease, oxygen and carbon dioxide exchange will be disrupted.[16].According to research conducted by Venkata, pregnant women with anemia will cause hypoxia. Hypoxia will increase the production of Vascular Endothelial Growth Factor (VEGF) and Placental Growth Factor (PLGF), which work for angiogenesis and placental vasculogenesis, which will trigger the formation of nitric oxide (NO). The NO produced can trigger placental endothelial dysfunction, resulting in nutrients and oxygen from the mother not being distributed to the fetus, resulting in growth disorders.[17]

Our findings are essential for strengthening maternal and child health in West Papua and other underserved populations in eastern Indonesia. The strategy should focus on improving maternal and fertile female literacy to prevent low birth weight. However, this study has several limitations, namely, using a cross-sectional research method so that it cannot measure anthropometry before pregnancy, the assessment of hemoglobin levels is only taken at the final trimester hemoglobin levels, the mother's age and parity are not homogeneous, the history of giving iron tablets is unknown.

Conclusion

Based on the study's results, it can be concluded that the hemoglobin levels of pregnant women who give birth to babies with low birth weights have lower hemoglobin levels than those who give birth to babies with normal birth weights. In addition, the birth weight of babies born at Manokwari Regional Hospital, West Papua, was mainly in the normal category (%), namely ≥

2500 grams. The results of the bivariate test in this study showed a significant relationship between hemoglobin levels in mothers who gave birth at term and birth weight at Manokwari Regional Hospital, West Papua (p <0.001). Future studies are adjusted to explain pregnant women's iron levels and nutrition intake.

Acknowledgments

We thank all participants and the laboratory analyst, nurse, and doctor in Manokwati Hospital, West Papua, for helping in the sample assessment.

Declaration Of Conflicting Interest

No potential conflicts relevant to this article were reported.

Funding Statement

This study does not have external funding.

Ethical Approval And Informed Consent Statements

The study has been approved by the ethical committee from Catholic Soegijapranata University Number 0002/B.72/UN.KEEP/09/2023.

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