

The Effect of Maternal Anemia on Low Birth Weight: A Systematic Review And Meta Analysis

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ABSTRACT

Background: Low birth weight (LBW) is a risk factor for morbidity and mortality in infants. Several previous studies have suggested that maternal anemia has an effect on several adverse perinatal outcomes, including low birth weight. The purpose of this study was to investigate the effect of anemia in pregnant women on the incidence of low birth weight.

Subjects and Method: This study is a systematic review and meta-analysis done by searching for articles published by the online database PubMed, ResearchGate, Science Direct, Google Scholar and EBSCO in 2016 to 2021. Population: pregnant women, intervention: anemia, comparison: no anemia, and outcome: low birth weight). Data analysis using RevMan software version 5.3.

Results: Pregnant women who experience anemia during their pregnancy are at risk of giving birth to babies with low birth weight compared to mothers who are not anemic (OR= 3.42; 95% CI= 1.85-6.34; $p < 0.001$).

Conclusion: Mothers who experience anemia during pregnancy is one of the risk factors for the occurrence of babies with low birth weight.

Keywords: low birth weight, maternal anemia, risk factors

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BACKGROUND

Globally, about 30 million babies are born with low birth weight (LBW) every year. It accounts for 23.4% of the total of all births (Louis et al., 2016). Worldwide, high LBW rates continue to hinder global efforts to reduce infant mortality and improve the quality of child growth. Overall, it is estimated that LBW is a significant underlying factor in >80% of neonatal deaths (ie, mortality <28 days after birth) (Katz et al., 2013).

LBW is the most important indicator of perinatal and infant mortality and morbidity, and affects health in adulthood. Based on international epidemiological observations, babies weighing less than 2,500 grams are 20 times more likely to die than babies weighing more than 2,500 grams. LBW infants also have a greater chance of suffering from malnutrition, diarrhea, neurodevelopmental problems, physical disabilities, incidence of umbilical sepsis, eye disorders (ophthalmology), hearing loss, neonatal jaundice, respiratory tract

infections, and the most common finding is neonatal asphyxia. LBW infants are at high risk of developing chronic adult diseases, such as type II diabetes, hypertension, and cardiovascular disease in adulthood (Bari et al., 1970; Goldenberg and Culhane, 2007; Goldberg and Prentice, 1994; Idris et al., 2000; Kramer, 1987; Park, 2007; UNICEF and WHO, 2004; Bari et al., 1970). Another impact of LBW is a higher risk of infection, poor mental development, stunting, kidney disease in old age, eye problems, deafness, neurological complications such as cerebral palsy, developmental delays, seizures, and psychological disorders (Baye Mulu et al., 2020; Mengesha et al., 2017; Tosun et al., 2017; World Health Organization, 2011).

LBW is associated with first delivery (primi gravida), lack of antenatal care (ANC) visits and follow-up, and being HIV-positive. Baby girls experience more LBW than baby boys (Zelege et al., 2012). A study found that women who have given birth to LBW before are more likely to give birth to LBW babies again (Muula et al., 2011). A prospective study in a rural area in Kenya showed that socioeconomic factors were the best predictors of LBW and there were other related factors such as BMI, Hb levels and maternal arm circumference (Ngare & Neumann, 1998). A study conducted by Mitao in 2015 in Northern Tanzania stated that factors related to the incidence of LBW were maternal height, time of the first antenatal care (ANC) visit, number of ANC visits, iron supplementation, calcium supplementation, maternal education, all diseases during pregnancy, and hypertension (Mitao et al., 2016).

A study by Rajashree (2015) in Karnataka, India reported that there are multi-dimensional factors that cause the birth of LBW babies, namely: maternal age, literacy rate, birth spacing, daytime rest during pregnancy, low maternal weight gain

during pregnancy, and blood hemoglobin (Hb) levels (Rajashree et al., 2015). Anemia during pregnancy can cause low birth weight, premature birth, and perinatal, neonatal and maternal death (Haider et al., 2013; Rasmussen, 2001). This may be due to impaired transfer of hemoglobin to the fetus through the placenta, which results in the fetus experiencing impaired weight gain resulting in low birth weight (Novianti, 2018). Iron tablet supplementation reduces the risk of maternal anemia and iron deficiency in pregnancy but other positive effects on maternal and infant outcomes are less clear (Peña-Rosas et al., 2015).

Studies on the risk factors for the incidence of LBW has been widely discussed by previous researchers, but the specific relationship between the incidence of LBW with anemia and the administration of iron tablets to pregnant women is still limited. Based on the description of the problem, it is necessary to conduct research to determine the effect of anemia on LBW.

Therefore, this study aims to identify the effect of anemia in pregnant women on the incidence of low birth weight.

SUBJECTS AND METHOD

1. Study Design

The research design is a systematic review and meta-analysis.

2. Inclusion Criteria

Search articles using the PubMed online database. The articles used in this review are articles published from 2011 to 2021. In the article search process, researchers used the keywords “anemia”, “low birth weight”, “pregnant women”, and “Covid-19”.

The inclusion criteria of this study are: 1) articles that examine the risk of anemia in pregnant women on low birth-weight during the COVID-19 pandemic; 2) original research papers; 3) there is relationship data indicated by the effect size

odd ratio. The exclusion criteria for this study were: 1) articles in languages other than English and Indonesian; 2) review papers; 3) research data is incomplete or not available.

3. Variable

PICO (Population: Pregnant women, Intervention: Anemia, Comparison: No anemia, Outcome: Low birth weight).

4. Operational definition of Variables

Researchers defined LBW according to WHO statistical data indicators as babies weighing <2,500 grams, regardless of gestational age, while pregnancy anemia is a condition of the body with hemoglobin (Hb) levels in the blood <11g% in the 1st and 3rd trimesters or Hb levels <10.5 g% in the 2nd trimester.

5. Study Instrument

Search articles using online databases (PubMed, ResearchGate, Science Direct,

Google Scholar and EBSCO). The process of searching and filtering articles using a Prism diagram (chart 1). Articles that are included in this study must meet the inclusion criteria and have been reviewed using a critical appraisal in accordance with the research design of the article used, which is cross-sectional.

RESULTS

1.Characteristics of Research Articles

There are a total of 354 articles searched from the online databases PubMed, Research Gate, Science Direct, Google Scholar and EBSCO using the keywords “low birth weight”, AND “maternal anemia”, AND risk factors.” by choosing the year of publication between 2016-2021. There were a total of 9 articles that met the inclusion criteria and were processed in a qualitative and quantitative synthesis (Figure 1).

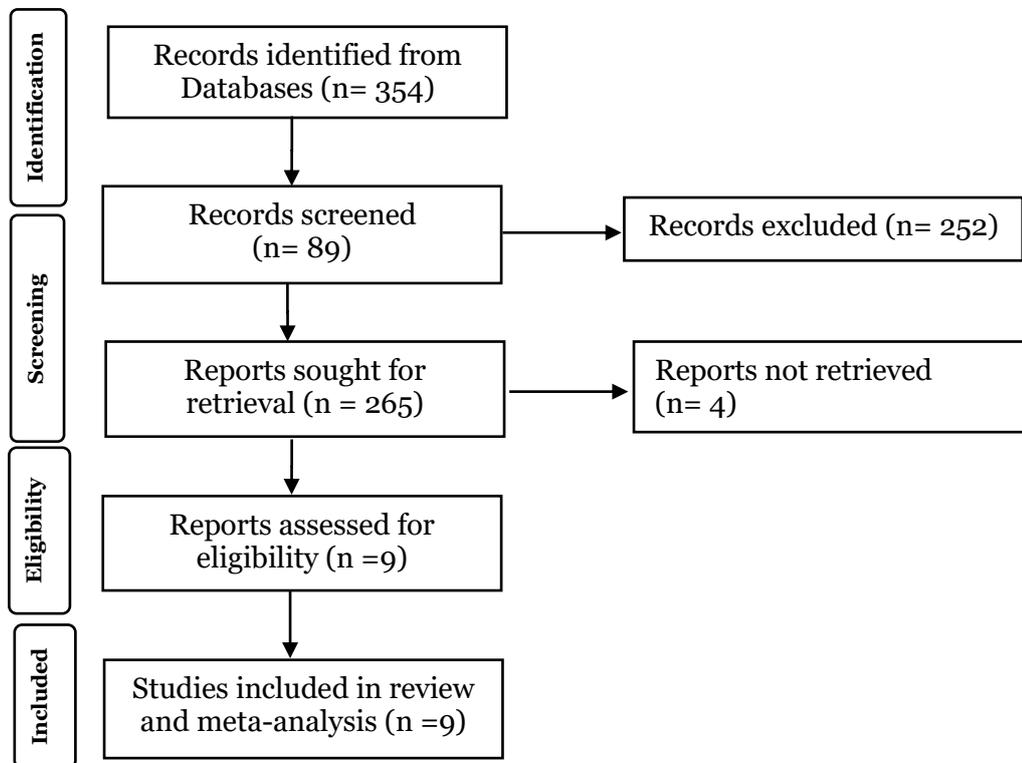


Figure 1. PRISMA Diagram

Table 1. Summary of characteristics in each article

No	Author (year)	Study Design	Subjects	Control	Results
1.	Abera et al., (2019)	A Cross-Sectional	29 LBW infants in anemic pregnant women. 33 LBW infants in non-anemic pregnant women.	37 normal weight infants in anemic mothers. 259 normal weight infants in non-anemic mothers.	Mothers who have anemia have a risk of giving birth to babies with low birth weight (AOR 3.42; 95% CI 1.73-6.78).
2.	Aboye et al., (2018)	A Cross-Sectional	12 LBW babies	17 normal weight babies	Mothers who had anemia had a greater risk of giving birth to low birth weight (AOR= 14.5; 95% CI 3.821–55.6).
3.	Ayne et al., (2020)	A Cross-Sectional	12 LBW infants in anemic mothers. 42 LBW babies in non-anemic mothers	9 normal weight babies in anemic mothers. 229 normal weight babies in non-anemic mothers	Mothers who have anemia are at greater risk for LBW delivery (AOR 9.15; 95% CI 2.31-36.30).
4.	Chanie dan Afenigus , (2018)	A Cross-Sectional	24 LBW infants in anemic mothers. 38 LBW babies in non-anemic mothers	46 normal weight infants in anemic mothers. 125 normal weight babies in non-anemic mothers	Mothers who have anemia are at greater risk of giving birth to low birth weight (AOR 0.129, 95% CI 0.016-1.011)
5.	Gebreha weryaet al., (2018)	A Cross-Sectional	26 LBW infants in anemic mothers. 70 LBW infants in non-anemic mothers	17 babies of normal weight in anemic mothers. 174 normal weight babies in non-anemic mothers	Mothers who had anemia had a greater risk of giving birth to low birth weight (AOR 3.91; 95% CI 1.73-8.87).
6.	Jember et al., (2020)	A Cross-Sectional	14 LBW infants in anemic mothers. 79 LBW infants in non-anemic mothers	9 normal weight babies in anemic mothers. 256 normal weight babies in non-anemic mothers	Mothers who had anemia had a greater risk of giving birth to low birth weight (AOR 0.8; 95% CI 0.17–4.56).
7.	Kumlac hew et al., (2018)	A Cross-Sectional	28 LBW in anemic mothers. 28 LBW in mothers who are not anemic.	37 babies of normal weight in anemic mothers. 282 normal weight infants in non-anemic mothers.	Pregnant women who have anemia are at greater risk of giving birth to low birth weight (AOR 2.6; 95% CI 1.03-7.0).
8.	Lake & Olana Fite, (2019)	A Cross-Sectional	26 LBW in anemic mothers. 22 LBW in mothers who are not anemic.	82 normal weight infants in anemic mothers. 174 normal weight infants in non-anemic mothers.	Mothers who have anemia have a risk of giving birth to babies with low birth weight (AOR 3,808; 95% CI 1,513-9,586).
9.	Mekie & Taklual, (2019)	A Cross-Sectional	7 LBW in anemic mothers. 27 LBW in mothers who are not anemic.	4 normal weight infants who were anemic. 244 normal weight infants who were not anemic.	Pregnant women who have anemia are at greater risk of giving birth to low birth weight (AOR 9.82; 95% CI 1.83-52.73).

The characteristics of each article included in the qualitative synthesis are described in table 1. The articles included in this systematic review and meta-analysis study are research articles using cross-sectional

research methods. Subjects included in this study were infants weighing <2500 grams and infants weighing 2500 grams as controls. All studies included in this

research analysis are located in the country of Ethiopia.

2. Effect of Maternal Anemia on the Incidence of LBW

The results of pooled odds ratio analysis showed that pregnant women who were anemic during pregnancy had an odds of 3.42 being more prone to giving birth to LBW babies compared to mothers who did not experience anemia, this result was statistically significant ($p < 0.0001$). The

heterogeneity value (I^2) showed the number 62% ($p = 0.006$), so the results of this meta-analysis used random effects (Figure 2).

Based on the funnel plot of the meta-analysis of the relationship between anemia in pregnant women and the incidence of LBW babies, there is a publication bias which is indicated by the asymmetry of the study by looking at the number of dots on the right and left sides and comparing it with the standard error (Figure 3).

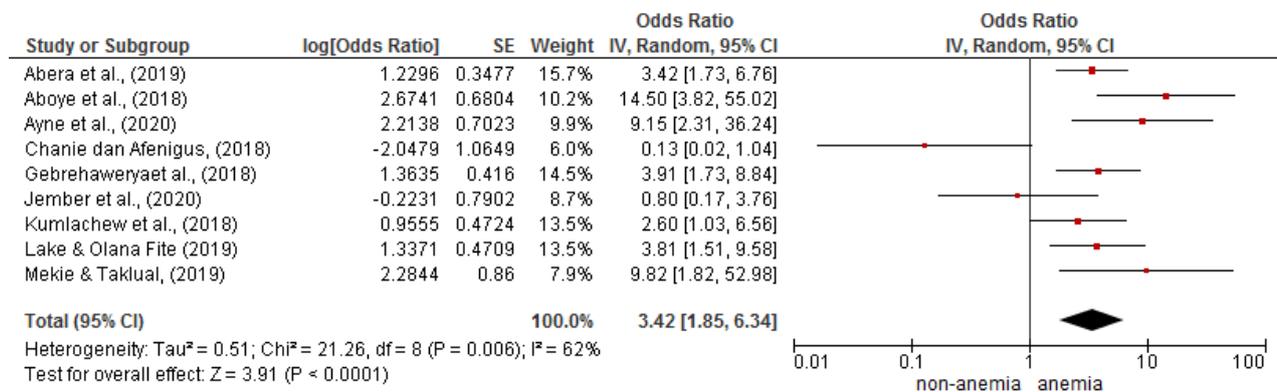


Figure 2. Forest plot of maternal anemia and low birth weight

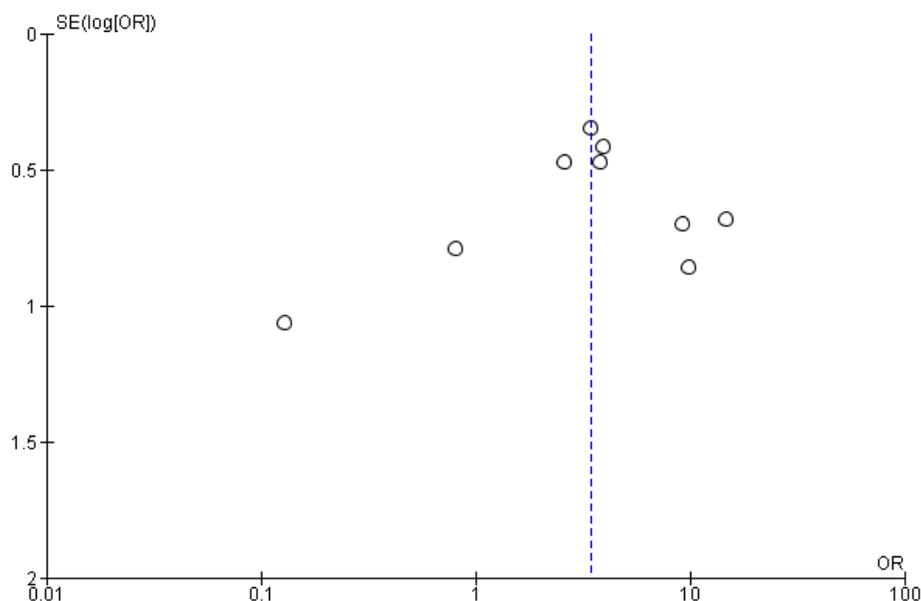


Figure 3. Funnel plot of maternal anemia and low birth weight

DISCUSSION

This study involved nine primary research articles from several countries in the world. However, the unique thing is that author

only found study articles located in the country of Ethiopia. The results of this meta-analysis explain that pregnant women

who experience anemia during pregnancy are more prone to giving birth to LBW babies compared to mothers who do not have anemia. This is in accordance with a meta-analysis study by Aditianti & Djaiman (2020) which states that the effect of anemic pregnant women on low birth weight is 1.49 times higher than mothers who are not anemic. The difference with this meta-analysis study is that the meta-analysis by Aditianti & Djaiman (2020) includes crude odd ratio data. The meta-analysis by Figueiredo et al., (2018) also states the same thing. The difference with this meta-analysis study is that the meta-analysis by Figueiredo et al., (2018) conducted an analysis of studies using a cohort and case-control research design. There is one other meta-analysis study which concluded that maternal anemia is a risk factor for LBW, namely the study by Rahman et al., 2016. The difference with this meta-analysis study is the meta-analysis by Rahman et al. (2016) conducted pooled analysis with effect size risk ratio (RR).

The classic risk factors for LBW are usually associated with inappropriate biological, social and environmental conditions that may occur in the mother before or during pregnancy (Carniel et al., 2008; Geib et al., 2010; Melo et al., 2007; UNICEF, 2004). According to Bresani et al., (2007) and Brannon & Taylor (2017), determinants related to nutrition, such as weight before pregnancy and weight gain during pregnancy also affect birth weight. This is related to inadequate maternal caloric intake, which may be caused by a poor diet and low absorption of essential micronutrients, such as vitamin B12 and iron for fetal growth.

According to Stangret et al., (2017) a decrease in hemoglobin levels supports changes in placental angiogenesis, thereby

limiting the availability of oxygen to the fetus and resulting in the potential for intrauterine growth restriction. This causes the baby to experience low birth weight. According to WHO (1992) other causes of anemia are parasitic diseases such as malaria, hookworm infection, and schistosomiasis; micronutrient deficiencies including folic acid, vitamin A, and vitamin B12; and genetically inherited hemoglobinopathies such as thalassemia. However, globally, the most common and most common cause of anemia is iron or hemoglobin deficiency (Stoltzfus and Dreyfuss (1998); WHO (2022)). Therefore, a study by Imdad and Bhutta (2012) stated that daily iron supplementation during pregnancy resulted in a significant reduction of 20% in the incidence of low birth weight infants.

Studies by Allen (2000) and Xiong et al., (200) also mention a significantly increased risk of preterm delivery if the mother is anemic in the first or second trimester of pregnancy. This can be related to the conclusion of a study by the United Nations Children's Fund and World Health Organization (2004) which states that the incidence of LBW is the result of premature birth, small birth at term, or a combination of both. Further studies on the analysis of the relationship between these three things, may be needed.

AUTHOR CONTRIBUTION

Fara Khansa Azizah is the main researcher who chooses the research topic, searches for and collects research data. Bhisma Murti and Yulia Lanti Retno Dewi who analyzed the data and reviewed the research manuscript.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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