

# Maternal Anemia in Third Trimester and Low Birth Weight (LBW): Systematic Review

Budi Prasetyo<sup>1</sup> Binar Choirun Najmi<sup>2</sup> Janatul Firdausi Nuzula<sup>2</sup> Hanik Badriyah Hidayati<sup>3</sup>

<sup>1</sup>Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Airlangga / Dr. Soetomo General Hospital Surabaya, East Java, Indonesia

<sup>2</sup>Midwifery Program, Faculty of Medicine, Universitas Airlangga, East Java, Indonesia<sup>3</sup>Department of Neurology, Faculty of Medicine, Universitas Airlangga / Dr. Soetomo General Hospital Surabaya, East Java, Indonesia.

\*Corresponding author: hanikhidayati@fk.unair.ac.id

## Abstract

**Background:** Babies with a low birth weight (LBW) are more likely to die or become ill. LBW refers to newborns who weigh less than 2,500 grams at birth. The presence of maternal anemia, or hemoglobin levels below 11 g/dL, is a significant risk factor for LBW. **Objective:** This study thoroughly investigated the connection between low birth weight and maternal anemia during the third trimester. **Methods:** This systematic review was conducted using the primary databases (PubMed, Science Direct, and Google Scholar), literature in Indonesian and English, and literature using cohort, cross-sectional, and case-control for the study researcher. **Results:** This systematic review included 5 cohort studies, 2 cross-sectional studies, and 1 case-control study after 2171 articles from a database were systematically examined with PRISMA. **Conclusion:** Maternal anemia in the third trimester is linked to low birth weight because third-trimester hemoglobin is a crucial factor in determining birth weight.

**Keywords:** maternal anemia; low birth weight; systematic review

## 1. Introduction

The United Nations Children's Fund (UNICEF) estimated in 2015 that low birth weight babies accounted for more than 20.5 million (14.6 percent) of all live births. A baby is considered to have low birth weight (LBW) if had weight less than 2,500 grams at birth (up to and including 2,499 grams). LBW infants are more likely to experience morbidity and mortality. These infants were more likely to die within the first 28 days of life, and those who did survive were more likely to develop adult-onset chronic conditions like diabetes and obesity, stunted growth, and a lower IQ. (1).

Among the many LBW factors are pregnancy, fetal, and maternal factors. One maternal factor that influences birth weight is nutritional determinants like weight before and during pregnancy. Due to inadequate maternal calorie intake, which may be caused by a diet that is incompatible with nutritional requirements, essential micronutrients for fetal growth like vitamin B12 and iron are poorly absorbed by the mother. Significant risk factors for LBW include pregnancy complications, gestational age below 37 weeks, parity (primipara and grandemultipara), maternal age (20 years or older), low maternal upper arm circumference, and hemoglobin levels below 11 gr/dL, also known as maternal anemia. (4).

Anemia, particularly in pregnant women, is the most typical public health issue. Anemia occurs when the mother's blood contains low levels of hemoglobin (Hb). According to the World Health Organization (WHO), 40% of pregnant women worldwide suffer from anemia. The most common causes of anemia are folate and iron deficiency, and women who did not

take iron and folic acid supplements before becoming pregnant are more likely to be malnourished.

Premature birth, low iron storage for the baby, and adverse pregnancy outcomes like LBW are all linked to anemia, which also contributes to delayed development. The majority of micronutrient-related complications in the third trimester occur during the fetal growth phase. In previous research, a significantly higher number of babies with low birth weights were born to mothers who were anemic in the third trimester. This systematic review is necessary to support the existing evidence and boost efforts to prevent anemia and low birth weight. (7) Therefore, the objective of this study was to demonstrate the link between maternal anemia during the third trimester and low birth weight.

## 2. Method

### 1. Search Strategies

Based on PRISMA, this study was a systematic literature and method review of articles published in electronic databases (PubMed, Google Scholar, and Science Direct) from April 25 to April 28, 2022. The Boolean Operators used in search strategies were “maternal anemia” OR “maternal hemoglobin” OR “anemia in pregnancy” AND “third trimester” AND “infant, low birth weight” OR “low birth weight.”

### 2. Inclusion and Exclusion Criteria

The literature found will be filtered using inclusion and exclusion criteria.

Inclusion Criteria:

1. Literature in Indonesian and English
2. Full paper articles
3. The literature discusses the relationship between anemia and LBW
4. The literature discusses anemia in the third trimester
5. The literature uses cohort, cross-sectional, and case-control for the study researcher

Exclusion Criteria

1. Literature that does not meet the keyword criteria
2. Duplicate articles
3. Systematic Review, Literature Review, and Meta-Analysis research methodology articles

### 3. Studies Selection

The systematic review included articles that satisfied the eligibility criteria. Two researchers independently assessed the publication's quality, and any disagreements were resolved through discussion until a consensus was reached. This systematic review made use of the JBI Critical Appraisal Checklist, which is a list of things that should be included in study reports, to determine the quality of the selected research. Cohort studies had 11 items on this checklist, case-control studies had 10 and cross-sectional studies had 8.

### 4. Data Extraction

Two researchers extracted data from the included articles and entered them into an extraction form along with the author's name and publication year, study type, title, sample size, country, and results. of low birth weight pregnancy in the third trimester of anemia.

### 5. Outcome of Interest

LBW and anemia during the third trimester are the results of interest. A baby who is born prematurely weighs less than 2,500 grams or LBW. A mother who has third-trimester anemia has a hemoglobin level of less than 11 g/dL.

### 6. Statistical Analysis

Due to the disparate measurement results from each study, a narrative synthesis was used rather than a meta-analysis.

## 3. Result

### 3.1 Selected Studies

2,171 records for papers published between 2012 and 2022 were found through database searches. Based on the results of the duplicate article screening, there were 320 duplicate articles. The association between third-trimester anemia and LBW was not examined in 1757 publications, and 28 articles did not use Indonesian or English. 42 articles failed to respond to research questions, and 16 articles were unavailable in their entirety. The inclusion criteria for this systematic review were met by only eight texts. (Figure 1).

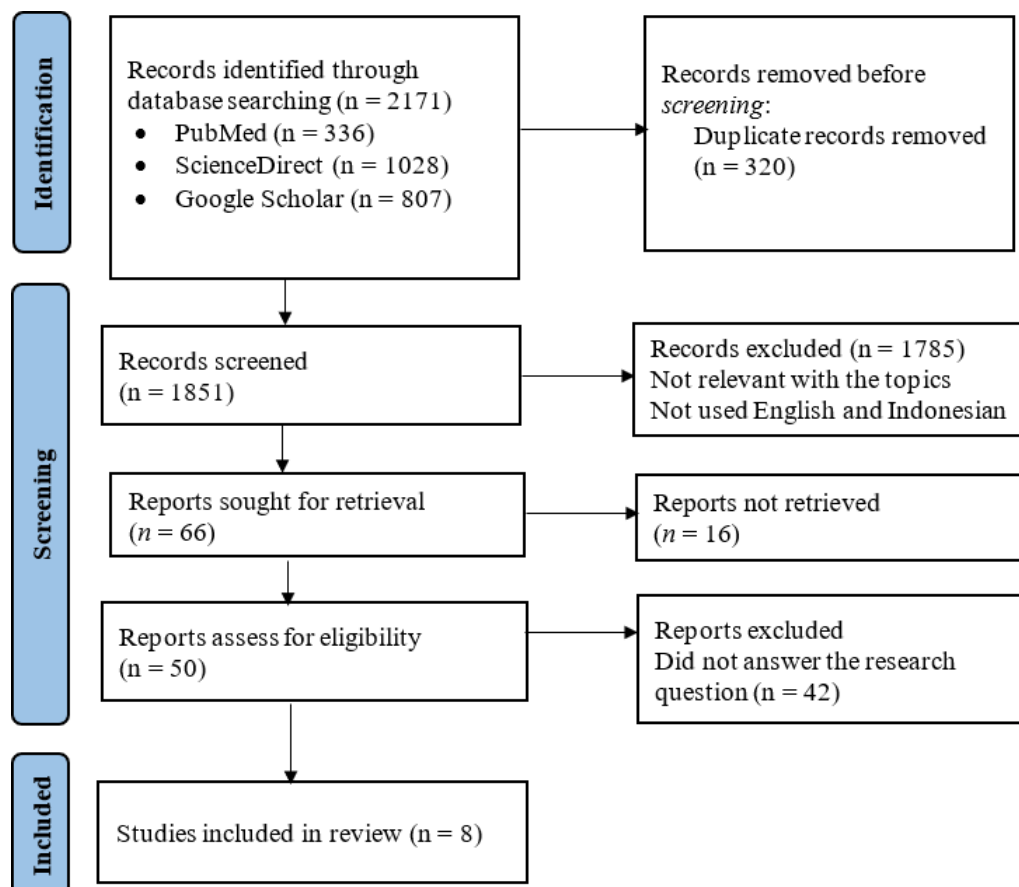


Figure 1. Flowchart of the search, selection, and inclusion of the studies.

### 3.2 Characteristics of Studies

Table 1. Characteristics of studies

Author-publication year- reference	Type of Study	Title	Sample size	Country	(M
Yildiz et al., 2014	Cohort	The relationship between third trimester maternal hemoglobin and birth weight/length; results from the tertiary center in Turkey	28.600	Turkey	Low hemo 1.08; 0.029
Huang et al., 2015	Cohort	The Influence of Iron-deficiency Anemia during the Pregnancy on Preterm Birth and Birth Weight in South China	500	China	Moth trime more weigh
Nair et al, 2016	Cohort	Association between maternal anaemia and pregnancy outcomes: a cohort study in Assam, India	1007	India	There and a (Mod OR 1 95%
Audrey and Candra, 2016	Cohort	Association Between Anemia Status of Third Trimester Pregnant Women With The Incidences of Low Birth Weight Babies	31	Indonesia	There frailty the fi (RR =
Arbedili and Kariman, 2018	Cohort	The Relationship Between the Incidence of Second and Third Trimester Hemoglobin and the Incidence of Preterm Birth and Birth Weight	600	Iran	Lower with durin (RR) times group
Nair et al., 2018	Case Control	Effect of Maternal Anemia on Birth Weight of Term Babies	200	India	It ha mater than babie

Yazdi et al., 2018	Cross Sectional	The Relationship between Maternal Hemoglobin and Hematocrits with Low Birth Weight and Preterm Labour	383	Iran	Low corre in the study
Shrestha and Shrestha, 2020	Cross Sectional	A Correlative Study between Maternal Hemoglobin Concentration during Third Trimester and Fetal Birth Weight of Babies Born at Kathmandu Medical College and Teaching Hospital	2417	Nepal	When anem more value hemo less t

Table 2 Assessment of literature quality with JBI

Articles	Cohort Studies							
	1	2	3	4	5	6	7	8
Yildiz et al, 2014	Y	Y	Y	Y	Y	Y	Y	Y
Huang et al., 2015	Y	Y	Y	N	N	Y	Y	Y
Nair et al, 2016	Y	Y	Y	Y	Y	Y	Y	Y
Audrey et al., 2016	Y	Y	Y	N	N	Y	Y	Y
Arbedili et al., 2018	Y	Y	Y	N	N	Y	Y	Y
	Case Control Studies							
	1	2	3	4	5	6	7	8
Nair et al., 2018	Y	Y	Y	N	N	Y	Y	Y
	Cross Sectional Studies							
	1	2	3	4	5	6	7	8
Yazdi et al., 2018	Y	Y	Y	Y	Y	Y	Y	Y
Shrestha et al., 2020	Y	Y	Y	Y	N	N	Y	Y

3.3 Five cohort studies, two cross-sectional studies, and a case-control study were included in this systematic review to examine the connection between low birth weight and maternal anemia during the third trimester. According to the p-value, Odds Ratio (OR), Relative Risk (RR), and 95% Confidence Interval (CI) for RR from each study, maternal anemia in the third trimester is associated with low birth weight, which can be demonstrated with the highest OR of 6,19 (1,44-26,71) (11) and RR of 3,32 (16).

#### 4. Discussion

The articles that came up in the search results were all from Asian countries. Because the prevalence of anemia in Asia remains extremely high, at approximately 48.2%, this is conceivable. Anemia during pregnancy is a common problem and a risk factor for many problems that come up during pregnancy. This systematic review found a link between maternal anemia and low birth weight in the third trimester. Pregnancy anemia also increases the risk of perinatal death, low birth weight, a small gestational age, and postpartum hemorrhage (11). Yildiz et al., claim that a study of 28,600 Turkish pregnant women found a link between low birth weight and low third-trimester hemoglobin levels (9).

In pregnant women, an increase in plasma volume greater than blood volume, a 20–25% increase in red blood cells, and a 30–40% increase in plasma volume and leads to physiological anemia in pregnant women (10). In addition, hemodilution, which may be exacerbated by an iron deficiency, frequently results in a slight drop in hemoglobin. On the other hand, pregnant women require more iron to support fetal growth (10, 12).

Iron-deficient pregnant women imperil the mother's life as well as the baby's life, and it can ruin the development and improvement of the fetus; The infant's birth weight is significantly influenced by the mother's hemoglobin levels (Hb) (17). Pregnancy anemia will cause placental oxygen and nutrition to not meet the fetus's growing needs and development, resulting in LBW (10). This will disrupt the flow of oxygen and nutrients from the mother to the fetus.

Another study found that maternal anemia was the cause of 33 of the 62 LBW cases associated with low third-trimester hemoglobin levels. It is possible to draw the conclusion that lower levels of hemoglobin raise the likelihood of low birth weight during the third trimester (13). In addition, these findings are consistent with research that was carried out in the same nation but utilized a different study design. That research revealed a strong connection between low levels of hemoglobin and low birth weight, particularly during the third trimester (15). This can happen because the placenta's smaller size and the smaller surface area mean that the baby is getting less food. Inadequate oxygen delivery to the fetus caused by low hemoglobin levels can also restrict intrauterine growth (10, 15).

Pregnant women in their third trimester are more likely to experience anemia as a result of the increased cell mass. By increasing maternal iron intake from 6 mg/day in the first trimester to 22 mg/day in the third, this risk must be maintained. (18,19).

To be sure, a Chinese study that focused on 116 pregnant women with whiteness in the third trimester discovered a positive relationship between Hb levels and birth weight that was simply tracked in women with a shortcoming in the third trimester of pregnancy (10).

The third trimester is known to be crucial for optimizing labor preparations. In addition, it is known that fetal growth is significant and that this trimester sees the greatest intake of

iron and other micronutrients. Anemia during pregnancy is independently associated with low birth weight due to a lack of iron stores to support placental growth and fetal development and appropriately expand red blood cell mass (20).

WHO has been recommending iron and folate supplements for pregnant women to help prevent and treat iron deficiency anemia. However, it was discovered that maternal education, low ANC frequency, and non-adherence to iron supplement consumption were the risk factors for anemia during pregnancy (12,13). Therefore, providing pregnant women with motivation, health provider education, and family support regarding the significance of a nutritious diet for pregnant women to avoid anemia should reduce the incidence of LBW (22, 23).

## 5. Limitation

The established inclusion and exclusion criteria are the source of the study's limitations. Additionally, the majority of the acquired items originate in Asian nations. Subsequently, the discoveries can't be summarized into different continents.

## 6. Conclusion

This study demonstrated that maternal anemia in the third trimester is associated with low birth weight due to the importance of third-trimester hemoglobin in determining birth weight. As a result, pregnant women should get prenatal care and take supplements to avoid anemia.

## References

1. UNICEF. Low birthweight - UNICEF DATA [Internet]. UNICEF. 2019 [cited 2022 Feb 10]. Available from: <https://data.unicef.org/topic/nutrition/low-birthweight/>
2. Muhadiroh. Mother Age, Paritas and Nutritional State Mother Status as A Risk Factor Lower Body Health Service in The Sidamulya Puskemas District Wanasari District Brebes. University Muhammadiyah Semarang. 2018;
3. Bresani CC, de Souza AI, Batista Filho M, Figueiroa JN. Anemia and iron deficiency in pregnant women: disagreements among the results of a cross-sectional study. *Revista Brasileira de Saúde Materno Infantil* [Internet]. 2007 Nov [cited 2022 Feb 15];7(SUPPL. 1):s15–21. Available from: <http://www.scielo.br/j/rbsmi/a/KPnkdZghyYhVgbVQxXG9vHs/abstract/?lang=en&stop=previous&format=html>
4. Lestari JF, Etika R, Lestari P. MATERNAL RISK FACTORS OF LOW BIRTH WEIGHT (LBW): SYSTEMATIC REVIEW. *Indonesian Midwifery and Health Sciences Journal* [Internet]. 2020 Sep 19 [cited 2022 Mar 5];4(1):73–81. Available from: <https://e-journal.unair.ac.id/IMHSJ/article/view/30095>
5. WHO. Anaemia [Internet]. WHO. 2020 [cited 2022 Mar 5]. Available from: [https://www.who.int/health-topics/anaemia#tab=tab\\_1](https://www.who.int/health-topics/anaemia#tab=tab_1)
6. WHO. Anaemia in women and children [Internet]. 2021 [cited 2022 Feb 4]. Available from: [https://www.who.int/data/gho/data/themes/topics/anaemia\\_in\\_women\\_and\\_children](https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children)

7. Jagadish Kumar K, Asha N, Srinivasa Murthy D, Sujatha M, Manjunath V. Maternal Anemia in Various Trimesters and its Effect on Newborn Weight and Maturity: An Observational Study [Internet]. Vol. 4, International Journal of Preventive Medicine. 2013. Available from: [www.ijpm.ir](http://www.ijpm.ir)
8. Rahmati S, Delpishe A, Azami M, Ahmadi MRH, Sayehmiri K. Maternal anemia during pregnancy and infant low birth weight: A systematic review and meta-analysis. *Int J Reprod Biomed*. 2017 Mar 1;15(3):125–34.
9. Yildiz Y, Özgü E, Unlu SB, Salman B, Eyi EGY. The relationship between third trimester maternal hemoglobin and birth weight/length; results from the tertiary center in Turkey. *J Matern Fetal Neonatal Med* [Internet]. 2014 [cited 2022 Feb 15];27(7):729–32. Available from: <https://pubmed.ncbi.nlm.nih.gov/23981184/>
10. Huang L, Purvarshi G, Wang S, Zhong L, Tang H. The influence of iron-deficiency anemia during the pregnancy on preterm birth and birth weight in South China. *article.foodnutritionresearch.com* [Internet]. 2015 [cited 2022 Feb 21];3(9):570–4. Available from: <http://article.foodnutritionresearch.com/pdf/jfnr-3-9-2.pdf>
11. Nair et al. Association between maternal anaemia and pregnancy outcomes: a cohort study in Assam, India. *gh.bmj.com* [Internet]. 2016 [cited 2022 Feb 21]; Available from: <https://gh.bmj.com/content/1/1/e000026>
12. Audrey HM, Candra A. Association Between Anemia Status of Third Trimester Pregnant Women With The Incidences of Low Birth Weight Babies. *Aryu Candra JKD*. 2016;5(4):966–71.
13. Arbedili N, Kariman N. The Relationship Between the Incidence of Second and Third Trimester Hemoglobin and the Incidence of Preterm Birth and Birth Weight. *ijwhr.net* [Internet]. 2018 [cited 2022 Feb 21]; Available from: <https://ijwhr.net/pdf.php?id=615>
14. Nair M, S. G, Yakoob R, N. C. C. Effect of maternal anaemia on birth weight of term babies. *Int J Contemp Pediatrics*. 2018 Apr 20;5(3):1019.
15. Yazdi ME, Kermani Moakhar H, Sovizi B. The Relationship between Maternal Haemoglobin and Haematocrit with Low Birth Weight and Preterm Labour. *Journal of Midwifery and Reproductive Health*. 2018;
16. Shrestha A, Shrestha S. A correlative study between maternal hemoglobin concentration during third trimester and fetal birth weight of babies born at Kathmandu Medical College and Teaching Hospital. *Journal of Pathology of Nepal*. 2020 Sep 30;10(2):1756–9.
17. Ditaningtias S, Agus Sulstiyono, Rachmah Indawati. Anemia sebagai Faktor Risiko Peningkatan Skor Kehamilan Berdasarkan Kartu Skor Poedji Rochjati [Internet]. *Majalah Obstetri & Ginekologi*. 2015 [cited 2022 Aug 11]. p. 90–6. Available from: <https://e-journal.unair.ac.id/MOG/article/view/2073/1517>
18. Eweis M, Farid EZ, El-Malky N, Abdel-Rasheed M, Salem S, Shawky S. Prevalence and determinants of anemia during the third trimester of pregnancy. *Clin Nutr ESPEN*. 2021 Aug 1;44:194–9.

19. Scholl TO. MATERNAL IRON STATUS: RELATION TO FETAL GROWTH, LENGTH OF GESTATION AND THE NEONATE'S IRON ENDOWMENT. *Nutr Rev* [Internet]. 2011 Nov [cited 2022 Mar 17];69(Suppl 1):S23. Available from: [/pmc/articles/PMC3227006/](https://pubmed.ncbi.nlm.nih.gov/23227006/)
20. Carpenter RM, Billah SM, Lyons GR, Siraj MS, Rahman QS, Thorsten V, et al. U-Shaped Association between Maternal Hemoglobin and Low Birth Weight in Rural Bangladesh. *American Journal of Tropical Medicine and Hygiene*. 2022 Feb 1;106(2):424–31.
21. WHO. for Maternal and Neonatal Care Standards INTEGRATED MANAGEMENT OF PREGNANCY AND CHILDBIRTH (IMPAC). 2006;
22. Johan I, Sunarsih. HUBUNGAN ANTARA PREEKLAMPSIA DENGAN KEJADIAN BBLR DAN ASFIKSIA NEONATORUM DI VK IRD RSUD DR. SOETOMO SURABAYA. *Midwifery Science Journal*. 2017;1:79–98.
23. Triharini M, Nursalam, Sulistyono A, Adriani M, Armini NKA, Nastiti AA. Adherence to iron supplementation amongst pregnant mothers in Surabaya, Indonesia: Perceived benefits, barriers and family support. *Int J Nurs Sci*. 2018 Jul 10;5(3):243–8.