

# Determinants of Anemia in Pregnant Mothers: Systematic Review and Meta-analysis

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## ABSTRACT

**Introduction:** Pregnant women are a group that is vulnerable to problems related to nutrition. One of the problems related to nutrition is anemia. If not treated properly, anemia can have an impact, both on pregnant women and on babies. The impact on pregnant women is the increased risk of postpartum hemorrhage. While in infants it can cause premature birth.

**Purpose of Review:** To review the evidence related to the determinants of anemia in pregnant women.

**Method:** This scoping review method uses the Arksey & O'Malley framework, consisting of five stages, namely identifying scoping review questions using the PEO framework. Then identify relevant articles by setting inclusion and exclusion criteria, then search for articles through relevant databases, namely Wiley on Library, PubMed, Science Direct, and Google Scholar. Selection of articles with Prism Flow Chart, which is used to describe the flow of article search, then do a Critical Appraisal to assess the quality of each article, perform data charting compiling, summarizing, and reporting the results. Results: Based on the search results obtained 9 articles. Which consists of 5 articles with grade A and 4 articles with grade B. and related to the method there are 4 articles with cross-sectional design, 1 cohort article, 1 case study article, 1 person product-moment correlation article, 2 qualitative articles. Obtained 4 themes, namely the factors that affect anemia in pregnant women, signs, and symptoms, handling, and impact of anemia in pregnant women. Out of the 9 obtained articles, most are in developing countries.

**Conclusion:** Based on the scoping review results, anemia in pregnant women is a severe problem because it is one of the causes of the Maternal Mortality Rate (MMR). Therefore, health workers need to know the factors supporting the occurrence of anemia in pregnant women including age, educational status, gestational age, economic status, adherence to consuming Fe tablets, malaria, hookworms. It is hoped that by knowing these factors, health workers can provide excellent service according to the community's needs.

**Keywords:** Anemia, Determinants, Factors, Pregnancy, Pregnant women.

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## INTRODUCTION

### Background

One of the things that require special attention is pregnant women because pregnant women are vulnerable to problems related to nutrition. One of the problems related to nutrition is anemia. During pregnancy, the need for iron increases.<sup>1</sup> An increase in the need for iron without adequate intake will decrease iron reserves and lead to anemia. An increase in plasma volume during pregnancy which starts from the 6th week and peaks at the 26th week causes anemia. One of the efforts made to prevent anemia is by giving 90 tablets of Fe tablets. However, even though every pregnant woman has been given tablet Fe supplementation, pregnant women still

experience anemia. It is partly due to the non-compliance of pregnant women in consuming Fe tablets.<sup>2</sup> Other factors that can cause anemia include education, economic status, age, parity, and gestational age. Anemia can have an impact on pregnant women and fetuses. The impact on pregnant women is increasing the risk of postpartum hemorrhage. Whereas in infants, it can cause premature births.<sup>1</sup>

### The Purpose

The purpose of the scoping review in this study is to review the evidence related to the determinants of anemia in pregnant women.

### Scoping Review Questions

What are the determinants of anemia in pregnant women?

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**RESEARCH METHOD**

This study uses a scoping review method. Scoping review aims to answer questions from a predetermined research topic using various sources of similar research articles, then grouping them and making conclusions. The stages carried out in this scoping review consist of:

- identifying the focus of the review,
- developing a review focus and search strategy using the PICO format (Population, Intervention, Comparison, and Outcome),
- identifying relevant studies,
- Mapping data using PRISMA Flowchart (Preferred Reporting Items for Systematic reviews and Meta-Analyses)
- Data Extraction by compiling, summarizing and reporting the results and discussion.

**Identifying Scoping Review Questions**

At this stage, identifying research questions is used as a reference in an article search. Developing research protocols is one way to conduct quality research because all stages and research processes are transparent, preventing rejection due to lack of coherence between the research design, and the results and conclusions obtained. Research protocols are also used to prevent the collection of unqualified sources from being used and used as material for conducting research. Scoping review questions are based on the phenomenon to be studied. Scoping review questions are different from research questions. To develop scoping review questions, use the PEOS/PET framework (Table 1). The PEOS framework is as follows:

Based on the PEOs framework above, questions that may be chosen include:

**Table 1:** Framework

Population	PEOs exposure	Outcome of
Pregnant Women in Third Trimester	HB Levels	Factors of anemia in Third Trimester Pregnant Women

**Tables. 2:** Library/Database/Search engine relevance

No	Database	Relevance
1	Wiley On Library	An online library platform with an integrated set of features can help professional researchers and other readers find and engage with the most relevant content. More advanced browsing functionality and user interface align with current best practices for user experience. A more accessible platform that delivers new features and functionality promptly.
2	PubMed	PubMed is a free database that leads to several databases of references and abstracts on MEDLINE natural science and biomedical topics. It saves searches, filters search results, manages automatic updates sent by email. It saves a collection of references retrieved as part of a PubMed search. Configure display formats or highlight search terms
3	Science Direct	Website that provides subscription access to scientific and medical research databases. The site contains more than 12 million content from 3,500 academic journals and 34,000 e-books. Journals are grouped into 4 sections: <i>Physical Science and Engineering, Life Science, Health Sciences, and Social Sciences and Humanities.</i> Article abstracts are available free of charge, but access to their full text (PDF and HTML) requires a subscription or pay-per-download account.
4	Google Scholar	Provides access to various databases that can make it easier for users to get ideas or ideas to create quality scientific papers. One of the databases that can be accessed by Aisyiyah University Yogyakarta.

- What are the factors driving anemia in pregnant women?
- What are the symptoms of anemia?
- How to handle the incidence of anemia in pregnant women?
- What are the effects of anemia on pregnant women?

**Identifying Relevant Aarticles**

It is done by determining key parameters, such as:

*Inclusion Criteria*

- Journals published in English and Indonesian
- Journals or articles published between 2010-2020
- Full text
- articles Journals or articles discussing Physiological Problems in Mothers pregnant
- Journals or articles that discuss Hb levels in pregnant women
- Journals or articles that discuss the factors of anemia in pregnant women
- Journals that discuss the signs and symptoms of anemia
- Journals that discuss the treatment of anemia in pregnant women
- Journals that discuss the impact of anemia

*Exclusion Criteria for Opinion*

- Articles
- Journals that discusses hypertension in pregnant women
- Journals that discuss blood transfusions
- Journals that discuss postpartum events in anemic mothers

*Search Strategies and Specific Keywords*

In this study, the search strategy and specific keywords used in the search process is a literature search using the database: PubMed, clinical Key, Willey, Science Direct, and Google Scholar (Table 2).

Articles are obtained based on the keywords (keywords) used in the review variables in the article. Keywords used:

- “Prenatal\*” OR “Pregnancy” OR “Maternity”
- “Anemia” OR Iron “Deficiency”
- “Factor: OR “Determinant” OR: “Determine”

In addition, the search strategy is performed using truncation/wildcard symbols and boolean strategic operators. Truncation/wildcard symbols is a search technique that refers to the ability to search only several portions of a word.<sup>3</sup> Usually, a symbol such as an asterisk (\*) is used to represent the remainder of the search term. Example; Read\*, then search engines will look for documents containing variants of the word swim such as reading, reads, reader, and other variants. In addition, you can also use Boolean searching, Boolean searching is a way to combine search words using several “connectors” or mathematical symbols in order to obtain the desired information retrieval results, including AND, OR, [, [+], [-].<sup>3</sup>

**Article Selection**

*PRISMA Flowchart*

At this stage, the researcher selects the literature obtained from various search engines that have been mentioned previously based on predetermined keywords. The literature obtained will be selected according to the inclusion and exclusion categories of the study. The articles reviewed are all articles from 2010–2020 (the last 10 years), using Indonesian or English, full text available, and specifically on the main question that is the focus of the review, namely the steps for compiling a research protocol. Based on the criteria and suitability of the literature with the research topic, 158 articles were obtained, then excluded because there were duplications into 7 articles. From 151 articles, further screening was carried out by reading the abstract and full text. The 9 selected articles were subjected to a critical appraisal to assess their quality, especially their suitability with the research objectives. In writing this scoping review, researchers documented a literature search following the 27-item Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (Figure 1). In addition, the researcher also uses PRISMA flow diagrams to detail the number of literature identified from the search

results, the screening process, the number of studies that meet the eligibility criteria, and the number of studies that will be included for a thorough review.

*Critical Appraisal*

After selecting a study, a Critical Appraisal is carried out to determine the quality of the selected articles. In assessing the quality of the article, the researcher conducted a critical appraisal using the Mixed Method Appraisal Tool (Table 3, 4 and 5). In facilitating the assessment of this article, in the scoring process, the researcher used Grade A (Good), B (Good Enough), and C (poor). In the assessment process using a score of 1-3 with the following qualifications:

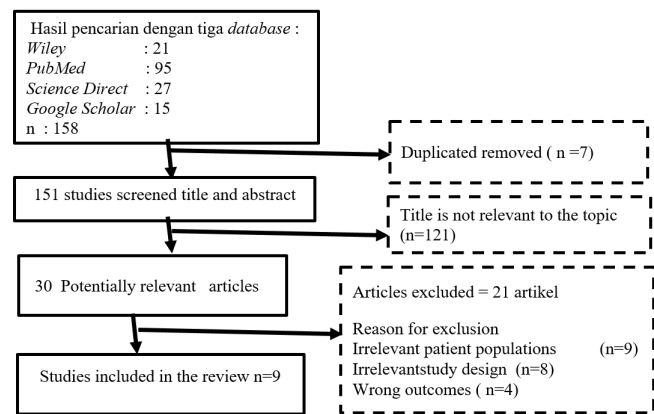
- 1 = No (does not answer questions)
- 2 = Can't Tell (answers questions but is not clear)
- 3 = Yes (answers questions) This

Critical Appraisal MMAT has seven questions, where each question has a score of 1-3. So that it can be concluded, the highest value of the total MMAT Critical Appraisal score is 21, the middle value is 14, and the lowest value is 7. So that in doing the article, it is included in the Grade A, Grade B, or Grade C categories by using the following references:

- Information :
2. Nwizu *et al.*, 2011: Socio-demographic and maternal factors in anemia in pregnancy at booking in Kano, Northern Nigeria
  3. Olujimi *et al.*, 2011: Prevalence of anemia among pregnant

**Table 3:** Range critical appraisal MMAT version 2018

Score Range	Grade	Category
15–20	A	Good
8–14	B	Fairly Good
< 7	C	Less Good



**Figure 3.1:** PRISMA diagram

**Table 4:** MMAT critical appraisal checklist quantitative non randomize (Cross-sectional and a retrospective study, cohort)

NO	Elements of assessment	Nwizu <i>et al.</i> , 2011	Olujimi <i>et al.</i> , 2011	Raisa <i>et al.</i> , 2020	Berharu <i>et al.</i> , 2020	Ayoub <i>et al.</i> , 2011	Shiavash <i>et al.</i> , 2016	Saydam <i>et al.</i> , 2017
1	Was the researcher's question clear?	3	2	3	3	3	2	3
2	Is the data collected possibly to answer the researcher's questions?	3	3	3	3	3	3	3
3	Is the sampling strategy relevant to answering the research question?	3	3	3	3	2	2	3
4	Are the participants representative of the target population?	3	3	3	3	2	2	2
5	Are there complete results data?	3	3	3	3	3	2	3
6	Are confounders taken into account in the design and analysis?	3	2	1	0	1	0	0
7	During the study period, was the intervention given (or exposure occurred) as intended?	0	0	0	0	0	0	0
Total Score/Grade		18/A	16/A	16/A	15/A	14/B	11/B	16/A

Woman at Booking on the University of Uyo Teaching Hospital, Uyo, Nigeria

5. Raisa *et al.*, 2020: Diagnostic Relevance of Ferrokinetic Laboratory Markers in Anemic Pregnant Woman
6. Berharu *et al.*, 2020: The Effect of Pregnancy in the Hemoglobin Concentration of Pregnant Woman: A Longitudinal Study
7. Ayoub *et al.*, 2011: Zinc, Parity, Infection, and Severe Anemia Among Pregnant Women in Kassla, Eastern Sudan
8. Shiavash *et al.*, 2016: Maternal hemoglobin concentrations before and during pregnancy and stillbirth risk: a population-based case-control study
9. Saydam *et al.*, 2017: Prevalence of Anemia and related factors among women in Turkey.

Remarks :

1. Julia *et al.*, 2020: Anemia
4. Nilesh, 2020: This is Normal during Pregnancy: ‘ A qualitative study of anemia-related perceptions and practices among pregnant woman in Mumbai, India

*Data Charting*

At this stage, all articles that have been selected are entered in a Table 6. This stage is similar to the extraction of data on a systematic review of

**Table 5:** MMAT critical appraisal checklist qualitative assessment

No.	Elements	Julia <i>et al.</i> , 2020	Nilesh <i>et al.</i> , 2020
1	Was the researcher’s question clear?	3	3
2	Is the data collected possibly to answer the researcher’s questions?	2	3
3	Is a qualitative approach appropriate for answering the research question?	3	3
4	Are the qualitative data collection methods sufficient to answer the research question?	2	2
5	Do the results of the research come from the data found?	3	3
6	Does the interpretation of the results prove the validity of the data held?	2	2
7	Is there any coherence between qualitative data sources, data collection, data analysis, and interpretation?	0	0
<b>Total Grade/Grade</b>		<b>15/B</b>	<b>14/B</b>

**Table 6:** Data extraction

No.	Title / Author / Year / Grade	Country	Aim	Type of research	Data collection	Participants / sample size	Result
1.	Julie T. Vieth, MbChB, David R.Lane 2020 Anemia	US	This study aims to review the evaluation and management of adult patients presenting to the ED with anemia.	Qualitative	-	Patients with anemia in the Department of Emergency Medicine, Medstar Washington Hospital Center, 110 Irving Street, North West, Washington, DC 20010, USA	Patients with anemia are frequently seen in the emergency department, and the attending physician often plays an important role in the evaluation and management of anemia. After diagnosing anemia based on a low hemoglobin, hematocrit, or red blood cell (RBC) count, the RBC index and peripheral blood should be evaluated. Iron deficiency anemia is common but can be treated, as in adults, with oral iron supplementation. Many other causes, including inherited disorders, such as sickle cell disease or thalassemia. Children who are anemic during the ED visit should be referred back to the pediatrician or primary care provider. Initial treatment of anemia depends on the clinical status of the patient. The decision to have a blood transfusion is not always easy, and it is not a decision to be taken lightly.

No.	Title / Author / Year / Grade	Country	Aim	Type of research	Data collection	Participants / sample size	Result
2.	Nwizu EN, Iliyasu Z, Ibrahim SA and Galadanci HS, 2011. <i>Socio-Demographic and Maternal Factors in Anemia in Pregnancy at Booking in Kano, Northern Nigeria</i>	Nigeria	To determine the prevalence, severity, and socio-demographic factors associated with anemia in pregnancy at baseline visit at Aminu Kano Teaching Hospital.	Descriptive and cross-sectional	Data collection begins with asking for the respondent's consent then conducting an ultrasound examination, then taking blood samples, conducting an open interview, after that, an in-depth interview using Swahili is carried out with investigations to explore the relevant topic thoroughly.	The study was conducted on pregnant women attending antenatal care for the first time at Aminu Kano Teaching hospital, Kano, Nigeria	Anemia in pregnancy still causes significant maternal morbidity and mortality in developing countries, including Nigeria. The burden and underlying factors varied even within countries, using capillary and blood film techniques, determined the packed cell volume (PCV) and red cell morphology of 300 pregnant women. Additional information was obtained about sociodemographic characteristics, obstetric and past medical history using a questionnaire provided by the interviewers. Of the 300 pregnant women studied, (17%) (95% Confidence Interval (CI) = 12.9% -21.7%) suffered from anemia. Specifically, 12.7% and 4.3% of women had mild and moderate anemia, respectively. Blood films of 74.5%, 15.7%, and 11.8% of anemic women showed normochromic normocytic, hemolytic, and microcytic hypochromic features. Low educational attainment [Adjusted Odds Ratio (AOR) = 2.13], single or divorced [AOR = 2.02], high parity [AOR = 2.06], late booking [AOR = 2.71] and short interval between pregnancy [AOR = 2.37] a significant predictor of anemia in pregnancy. The high prevalence of anemia in pregnancy is associated with low educational and economic status, especially in women with obstetric risk factors that require vigilance, continuous health education, and chemoprophylaxis in pregnant women, and the short interval between pregnancies [AOR = 2.37] is a significant predictor of anemia in pregnant women. pregnancy. The high prevalence of anemia in pregnancy is associated with low educational and economic status, especially in women with obstetric risk factors that require vigilance, continuous health education, and chemoprophylaxis in pregnant women and the short interval between pregnancies [AOR = 2.37] is a significant predictor of anemia in pregnant women. pregnancy. The high prevalence of anemia in pregnancy is associated with low educational and economic status, especially in women with obstetric risk factors, requiring vigilance, continuous health education, and chemoprophylaxis for pregnant women



No.	Title / Author / Year / Grade	Country	Aim	Type of research	Data collection	Participants / sample size	Result
3.	Olujimi A. Olatunbosun, Aniekam M. Abasiattai, Emem A. Basse. 2014. Prevalence of Anemia and Pregnant Woman at Booking on the University of Uyo Teaching Hospital, Uyo, Nigeria	Nigeria	To obtain relevant data to strengthen planning for the prevention of anemia in pregnancy, thereby helping to reduce the prevalence of anemia in pregnancy and the morbidity and mortality associated with it.	Cross-sectional	data were collected over sixteen weeks (July–October 2012); 400 pregnant women were recruited at their first antenatal visit. The women were interviewed with a copy of the structured questionnaire by a trained registrar in the Department of Obstetrics and Gynecology to obtain much necessary information. Then a blood sample was taken, 5mls of venous blood was collected from the antecubital vein using a disposable plastic syringe into a sample bottle containing ethylene diamine-tetra acetic acid (EDTA)	400 pregnant women at the first visit.	In this study, anemia in pregnancy is still very high, ie 89.9%. The investigators also revealed that the most important risk factors for anemia in pregnancy at this center were women's socioeconomic status, fever, and HIV seropositive status. The most common red cell features among anemic patients are microcytic hypochromic and normocytic hypochromic, which indicate iron deficiency anemia. Therefore, a public health campaign to create awareness about the importance of early booking for antenatal care is recommended
4.	Nilesh Chatterjee, Ph.D., MA, MBBS 2014 <i>This is Normal during Pregnancy: A qualitative study of anemia-related perceptions and practices among pregnant women in Mumbai, India</i>	India	This study explores perceptions and practices regarding anemia among pregnant women in Mumbai, India.	Descriptive qualitative research using in-depth interviews and focus group discussions	Data collection was carried out by open interviews or in-depth interviews, lasting 45 minutes on average, with 19 respondents and two focus group discussions (FGD), each lasting approximately 90 minutes with six respondents in each group who were	31 pregnant women aged 18 - 33 years; three women completed high school; 28 are housewives.	In this study, anemia is related to health, nutrition, culture, and gender. Interventions in this country should go beyond the distribution or monitoring of adherence to iron-folic acid supplements (IFA). Health education programs for women and household members should highlight the seriousness of anemia and pay attention to socio-cultural norms and gender behavior concerning nutrition and health in the family.
5.	Raisa Aringazina Gulmira Zharmakhanova Gulnara Kurmanalina Anes Bekkuzhin Bakhtiyar Kurmanalin. 2020. <i>Diagnostic Relevance of Ferrokinetic Laboratory Markers in Anemic Pregnant Woman</i>	Kazakhstan	To investigate the diagnostic role of ferrokinetic and hematological markers of anemia and their influence on the development of anemia, and determine reference values for revealing anemia syndromes in pregnant women.	Correlation analysis was performed using the Pearson method.	Data collection on 140 anemic patients was examined. The control group consisted of 50 pregnant women without anemia and disorders other heavy, 48 pregnant women IDA, and 42 maternal anemia due to chronic diseases, including rheumatoid arthritis	140 pregnant women attending gynecology clinic,	laboratory testing showed that 27% of patients examined had signs of IDA, 25% were diagnosed with anemia of chronic disease, and 28% had normal blood iron levels. Anemic patients experienced decreased hematocrit concentration, red blood cell count, erythrocyte volume, average Hb content in erythrocytes, and several adults. Measurement of Hb remains the most common indicator for diagnosing iron deficiency during pregnancy although it is a test for anemia and not a method for determining iron deficiency. The correlation between ferritin level, Hb content, and sTfR was determined in this study. The results showed that serum iron levels were highly correlated with total iron levels. The coefficient of determination for experimental data varies within 0.8. The increase in the serum ferritin concentration was consistent with the increase in the hemoglobin level.

No.	Title / Author / Year / Grade	Country	Aim	Type of research	Data collection	Participants / sample size	Result
6.	Berhanu Eifu Feleke 1 and Teferi Eifu Feleke 2020 <i>The Effect of Pregnancy in the Hemoglobin Concentration of Pregnant Woman: A Longitudinal Study</i>	Ethiopia	purpose of this research is to predict and identify the determinants of hemoglobin concentration before pregnancy, during pregnancy, and after childbirth and labor	studies prospective cohort	Data were collected utilizing interviews, review of medical records, and laboratory sampling (blood and feces).	A total of 1709 pregnant women respondents.	In this study, the average hemoglobin concentration in primigravida and multigravida women before pregnancy was 12.41 g/dl and 10.78 g/dl, respectively. The hemoglobin concentration decreased with successive trimesters reaching its lowest level at 42 days after delivery. The hemoglobin concentration of pregnant women was lowered by hookworm 0.24 g/dl multiple pregnancy 0.16 g/dl, episiotomy 0.05 g/dl, gravidity 0.15 g/dl, age 0.03 g/dl, and gestational age 0.1 g/dl. Hemoglobin concentration increased with iron supplementation of 1.02 g/dl and birth weight of 0.14 g/dl. Pregnancy significantly reduces the hemoglobin concentration of pregnant women which reaches its lowest point during labor
7.	Ayoub A. Mohamed & Abdel Aziem A. Ali & Naji I. Ali & Elshafae H. Abusalama & Mustafa I. Elbashir & Ishag Adam. 2011. <i>Zinc, Parity, Infection, and Severe Anemia Among Pregnant Women in Kassala, Eastern Sudan</i>	Sudan	To determine the prevalence and to determine the determinants of anemia in pregnant women in Kassala in eastern Sudan.	Cross-sectional	Data collection began with interviews, then venous blood was collected for examination of	250 pregnant women.	In this study, of 250 women, 146 (58.4%) had anemia, 17 (6.8%) had severe anemia, 49 (19.6%) had iron deficiency, 37 (14.8%) had iron deficiency anemia, and 95 (38%) women had anemia. There was no significant correlation between hemoglobin, S-zinc, and S-ferritin. There was a significant positive correlation between hemoglobin and S-albumin ( $r = 0.308$ , $P = 0.001$ ) and a significant inverse correlation between hemoglobin and C-reactive protein ( $r = 0.169$ , $P = 0.007$ ).
8.	Siavash Maghsoudlou, et al. 2016 <i>Maternal hemoglobin concentrations before and during pregnancy and stillbirth risk: a population-based case-control study</i>	Iran	To examine the association of maternal hemoglobin concentration, hemoglobin dilution, and risk of stillbirth.	case-control study	Data were drawn from pre-pregnancy, pregnancy, and delivery records, and information was entered using Access software by ten specially trained medical students. Every record, including information about the mother, child, and spouse, receives a unique code at the time of data collection and the code used during data entry to identify individuals and allow to analyze the data anonymously	495 stillbirths were selected as cases	hemoglobin concentration before pregnancy was not associated with stillbirth risk. High hemoglobin levels and the absence of hemoglobin dilution during pregnancy can be considered as indicators of high-risk pregnancy, the lack of association between hemoglobin concentration before pregnancy and stillbirth in this study could be because women with low hemoglobin concentrations received pharmacological treatment before pregnancy. According to routines in Iran's primary health care system, more than 90% of pregnant women receive iron and other micro-supplements after the 16th week of pregnancy. In addition, women of reproductive age undergo screening to identify and treat iron deficiency anemia, especially before pregnancy, increasing hemoglobin concentrations.

No.	Title / Author / Year / Grade	Country	Aim	Type of research	Data collection	Participants / sample size	Result
9.	Birsen Karaca Saydam et al. 2017 <i>Prevalence of Anemia and related factors among women in Turkey.</i>	Turkey	To determine the prevalence of anemia and related factors in women in Turkey.	Cross-Sectional	The data collection method was conducted by interviewing	418 respondents.	The overall prevalence of anemia among research subjects was set to be 27.8%. Of all the anemia diagnoses in these women, 56.0% were iron deficiency, 37.1% iron deficiency anemia, and 6.9% severe anemia, these rates for all women were 15.6%, 10.3%, and 1.9%, respectively. The mean age of the women was 45.16 ± 16.21 years. The results showed that the prevalence of anemia in women of childbearing age was higher. To prevent anemia at a low cost, it is recommended to provide women with relevant information and well-planned interactive educational programs.

*Literature Mapping*

Based on 9 articles that have been selected and following good quality, then data extraction is carried out to classify several points or parts of the article such as research objectives, research design, number of samples, and the results or findings of the research. However, previously the article was coded first, then literature mapping was carried out in the scoping of this review (Table 7 and 8).

**RESULTS AND DISCUSSIONS**

**Results**

*Study Characteristics*

*A. Research Design*

results of a scoping review search with the title Determinants of Anemia Decrease in Third Trimester Pregnant Women using five databases obtained from 9 different journals. There were four articles with a cross-sectional design, one cohort article, one case study article, one person product moment correlation article, and two qualitative articles. It can be seen in the Figure 2:

*B. Country*

Based on where the research was conducted, there was 1 study in the United States, 2 studies conducted in Nigeria, 1 study in Kazakhstan, 1 study in Iran, 1 study in Sudan, 1 study in Ethiopia, and 1 study in Ethiopia. Study in India. and 2 studies were conducted in Nigeria, 1 in Guangdong China, 1 study in Ethiopia.

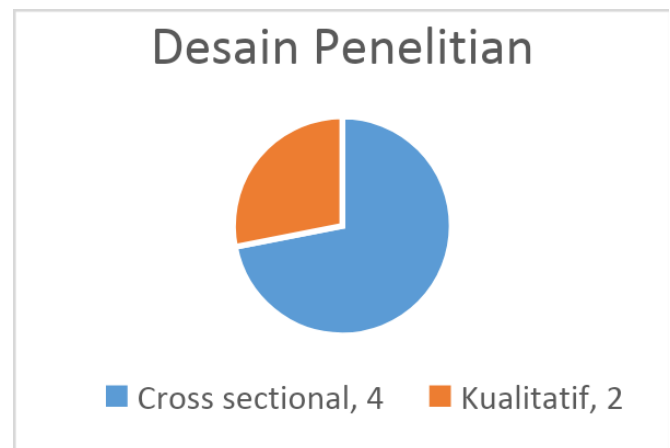
*C. Grade*

Quality of the studies when the Critical Appraisal has been carried out is 5 studies with Grade (A) and 4 studies with Grade (B)

**Discussion**

*A. Factors Influencing Anemia in Pregnant Women*

Anemia is a condition in which the body experiences a decrease in the number of circulating erythrocytes or red blood cells, or as a decrease in hemoglobin concentration (a tetramer



**Figure 2:** Study Characteristics



**Table 7:** Coding of research articles

No.	Title	Code
1	Julie T. Vieth, MbChB, David R. Lane. 2020. Anemia	(A1)
2	Nwizu EN, Iliyasu Z, Ibrahim SA and Galadanci HS, 2011. Socio-Demographic and Maternal Factors in Anemia in Pregnancy at Booking in Kano, Northern Nigeria	(A2)
3	Olujimi A. Olatunbosun, Aniekan M. Abasiattai, Emem A. Basse. 2014. Prevalence of Anemia among Pregnant Woman at Booking on the University of Uyo Teaching Hospital, Uyo, Nigeria	(A3)
4	Nilesh Chatterjee. 2014 <i>This is Normal during Pregnancy: 'A qualitative study of anemia-related perceptions and practices among pregnant woman in Mumbai, India</i>	(A4)
5	Raisa Aringazina Gulmira Zharmakhanova Gulnara Kurmanalina Anes Bekkuzhin Bakhtiyar Kurmanalin. 2020. <i>Diagnostic Relevance of Ferrokinetic Laboratory Markers in Anemic Pregnant Woman</i>	(A5)
6	Berhanu Elfu Feleke 1 and Teferi Elfu Feleke. 2020 <i>The Effect of Pregnancy in the Hemoglobin Concentration of Pregnant Woman: A Longitudinal Study</i>	(A6)
7	Ayoub et al., 2011 <i>Zinc, Parity, Infection, and Severe Anemia Among Pregnant Women in Kassla, Eastern Sudan</i>	(A7)
8	Siavash Maghsoudlou, et al., 1.2016. <i>Maternal hemoglobin concentrations before and during pregnancy and stillbirth risk: a population-based case-control study</i>	(A8)
9	Birsen Karaca Saydam, et al., 1. 2017 <i>Prevalence of Anemia and related factors among women in Turkey.</i>	(A9)

**Table 8:** Characteristics of articles

Country	Quality of	Research methodology	Respondents
Advanced: A1	Grade A (Good) : A2, A3, A5, A6, A9	Qualitative : A1 and A4	Globally anemic patients : A1, A9
Developing : A2, A3, A4, A5, A6 ,A7,A8	Grade B (Good Enough) : A1, A4, A7, A8	Quantitative : A2, A3, A5, A6, A7, A8	Babies : A8 Pregnant women : A2, A3, A4, A5, A6, A7

**Theme**

Factors -factors that affect anemia	Age : A2,A3,A4, A8 Parity: A4, A8 UK: A4 Compliance with Fe tablet consumption: A4, Education : A2, A4, A2,A7 Marital Status: A2 Economy: A2, A3, A4 Disease Endemic ( Malaria) : A2 Fever: A3 Hookworm: A6, A7 Twin Pregnancy: A6
Signs and Symptoms	Feeling easily tired, weak, thirsty, lethargic, dizzy or lightheaded, chest pain, dyspnea, and decreased exercise tolerance: A1
Management of Anemia	Supplementation Fe tablets: A2, A3 Nutritious food: A4, A2
Impact of anemia	Bleeding: A4 born baby Premature: A4 LBW: A4 Poor intellectual growth: A4 Congestive heart failure and kidney failure: A6

consisting of 2 pairs of polypeptide/globin chains, with each chain containing a heme complex) containing iron for oxygen binding). The structure of hemoglobin is under genetic and environmental influences.<sup>4</sup>

According to the WHO criteria, the minimum acceptable average hemoglobin level during pregnancy is 11 g/dL

(PCV 33%) in the first half of pregnancy and 10.5 g/dL in the second half. WHO divides anemia into 3 classifications, namely mild anemia (Hemoglobin 10–10.9 g/dL), moderate anemia (Hemoglobin 7.0–9.0 g/dL), and severe anemia (Hemoglobin < 7 g/dL).<sup>5</sup>

Hemoglobin itself is a tetramer whose structure consists of 2 pairs of polypeptide (globin) chains, each of which contains a heme complex containing iron as an oxygen binder.<sup>4</sup>

During the first 10 weeks of pregnancy, iron needs are lower when compared to non-pregnant women. However, there was an increase from 0.8 mg/day in the third trimester to 7.5 mg/day in the third trimester. Reserves of iron are contained in the body of about 500 mg, but only 15–20% of women have reserves. In the second and third trimesters, there is an increase in the need for iron to require iron supplementation. Although iron requirements are greater during pregnancy, women at this stage of life may have less energy and prepare meals due to physical constraints.<sup>6</sup>

During pregnancy, there are significant changes in mother’s hemostatic profile, including the dilution of hemoglobin due to an increase in the blood serum component. During pregnancy, blood volume increases by up to 50% so that more iron is needed to form hemoglobin levels.<sup>7</sup> In addition, the growth of the fetus and the formation of the placenta can cause blood volume to increase. In pregnancy, the increased blood volume is greater than the increase in erythrocytes, causing a decrease in hemoglobin concentration due to hemodilution.<sup>6</sup> During pregnancy, plasma renin activity increases and decreases

in atrial natriuretic peptide levels to meet the need for new vascular beds. High maternal erythropoietin secretion during pregnancy causes an increase in red blood cell mass. However, this increase is smaller than the change in plasma volume, which causes a decrease in hemoglobin concentration per liter of plasma by 10 to 20 grams by the end of the second trimester of normal pregnancy.

During pregnancy, fulfilling nutritional intake for the mother and fetus is very important. Lack of nutrition can cause several problems in pregnant women, including anemia, hypertension, diabetes mellitus, and even maternal death. While in infants can cause the risk of premature birth, low birth weight babies. Therefore, it is very important to ensure that the nutritional intake obtained by the mother is adequate to optimize the health of the mother and fetus.<sup>8</sup> During this critical period, women need to receive adequate evidence-based information and support to meet their nutritional needs.<sup>9</sup>

Anemia is a serious problem. One of the causes of the high maternal mortality rate is bleeding closely related to anemia. The factors of the occurrence of anemia include economic status, education, and adherence to consuming Fe tablets. Signs of a decrease in hemoglobin levels include feeling easily tired, weak, dizzy.<sup>10</sup> Other problems experienced by pregnant women have decreased appetite, nausea, vomiting, and reluctance to consume certain foods.<sup>11</sup>

Anemia is a condition in which the body has fewer circulating erythrocytes or red blood cells. In addition to iron deficiency, the decrease in hemoglobin levels is influenced by maternal age, educational status, employment status, parity, gestational age, multiple pregnancies, and adherence to consuming Fe tablets.<sup>4,11</sup> Age is one of the factors that encourage anemia. With increasing age each year, the hemoglobin concentration will decrease by 0.03 g/dL. This is because pregnancy in old age is associated with various complications. While at the age of fewer than 20 years, still need iron for growth. So it requires double iron, namely for its growth period and pregnancy.<sup>12</sup>

Multiple pregnancies can also lower the hemoglobin concentration of pregnant women by 0.16 g/dL. Twin pregnancies increase blood volume which causes hemodilution and ultimately decreases the hemoglobin concentration of the woman. Hookworms can also lower the hemoglobin concentration of pregnant women by 0.24 g/dL. This is because hookworms in principle digest red blood cells from the host.<sup>12</sup> The high prevalence of anemia in pregnancy is associated with low educational and economic status, especially in women with obstetric risk factors that require vigilance, continuous health education, and chemoprophylaxis in pregnant women and the short interval between pregnancies [AOR = 2.37] is a significant predictor of anemia in pregnant women. pregnancy. The high prevalence of anemia in pregnancy is associated with low educational and economic status, especially in women with obstetric risk factors that require vigilance, continuous health education, and chemoprophylaxis in pregnant women and the short interval between pregnancies [AOR = 2.37] is a significant predictor of anemia in pregnant women. pregnancy.<sup>8</sup>

Educational status can affect the decrease in hemoglobin levels related to the mother's level of knowledge. The higher the education level of pregnant women regarding nutrition and health, the more diverse they will be in consuming food to fulfill nutritional needs. Conversely, the lower a person's education, the religious nutritional needs cannot be fulfilled. Occupational status can influence the decrease in hemoglobin levels related to buying food. Pregnant women who have good or sufficient economic status can buy nutritious food. On the other hand, pregnant women with low economic capacity have difficulty buying nutritious food.<sup>8,9</sup>

Parity is also a driving factor for anemia. It is generally believed that anemia in pregnancy increases with increasing parity, due to repeated depletion of iron stores. This is because the more parity, the iron need is still low compared to women with lower parity who order later in life when the iron need is much higher, causing them to experience anemia.<sup>8,9</sup> Parity or the number of times in a year. Childbirth can affect the occurrence of a decrease in hemoglobin levels because someone who has given birth several times has a greater risk of blood loss so that it can affect the decrease in hemoglobin levels. For women who have given birth more than 2 times, but experience pregnancy again, there will be a decline in health and experience blood shortages.<sup>8-11</sup>

In addition, compliance in consuming Fe tablets can affect the occurrence of a decrease in hemoglobin levels because during pregnancy the need for pregnant women for iron increases, thus requiring support for iron supplementation to meet these needs. If pregnant women are not obedient in consuming Fe tablets, it can cause a decrease in hemoglobin levels. Non-adherence in consuming Fe tablets is usually related to the Fe tablets' side effects, including nausea, vomiting, stomach pain, and the distinctive odor of the Fe tablets.<sup>8-11</sup> In addition to the various factors above, endemic diseases also affect the occurrence of anemia. One of the endemic diseases that can affect anemia is malaria. Malaria disease is probably caused by malarial infestation which is endemic in the study area and is a common cause of febrile illness in pregnant women due to increased susceptibility during pregnancy. This is in line with previous studies in other parts of Nigeria, which showed that malaria is still a major problem among our pregnant women.

Hookworms can also lower the hemoglobin concentration of pregnant women by 0.24 g/dL. This is because hookworms in principle digest red blood cells from the host.<sup>13,21</sup>

#### *Signs and Symptoms of Anemia*

Early signs and symptoms of anemia are caused by tissue hypoxia and physiological compensatory mechanisms. Because the oxygen-carrying capacity usually exceeds oxygen demand by a factor of 4 at rest, hemoglobin levels can drop significantly before the patient signs or symptoms of anemia. No specific hemoglobin concentration causes symptoms; However, most adult patients will report symptoms once the hemoglobin level drops to less than 7 g/dL. 26,27 Patients who have chronic anemia or an inherited form of anemia (eg,

sickle cell disease, hereditary spherocytosis) may not report symptoms until hemoglobin decreases to less than 5 g/dL.<sup>4</sup>

Pallor, jaundice, or scleral jaundice may indicate hemolytic anemia on physical examination. Signs of an underlying cause may also include thyromegaly, lymphadenopathy, heart murmur, crackles on lung auscultation, hepatomegaly or splenomegaly, palpable mass, abdominal distension with fluid waves, abdominal pain, swelling or joint deformity, rash or petechiae, and melena or blood.<sup>4</sup>

Pregnant women who experience a decrease in hemoglobin levels experience symptoms including fatigue, weakness, thirst, lethargy, dizziness or lightheadedness, chest pain, dyspnea, and decreased exercise tolerance. In the elderly, increased falls, impaired cognition, and general physical decline may also occur.<sup>4</sup> Weakness and dizziness are symptoms of anemia. They attribute the cause to a poor diet.<sup>10</sup>

#### *Handling of Anemia in Pregnant Women*

In dealing with the decrease in hemoglobin levels in pregnant women, data using iron supplementation (Fe tablets). Iron is needed during pregnancy for the baby, the placenta, and an increase in red blood cells in pregnant women to cover iron needs. In the second trimester of pregnancy, the need for iron is higher and will continue to increase until the end of pregnancy. In addition, it is also recommended to meet adequate nutritional needs.

Iron supplementation during pregnancy has been shown to increase the hemoglobin concentration of pregnant women by 1.02 g/dL. The average hemoglobin concentration of women with a history of iron supplementation during pregnancy was 1.02 g/dL higher. This is because of the role of iron in the formation of red blood cells.

#### *The Impact of Anemia on Pregnant Women*

Anemia can cause problems for the mother, including the risk of bleeding that can cause death and the risk of heart failure during childbirth. In addition, it can also affect babies, can cause babies to be born with low weight, poor intellectual growth, weak children, and even cause death.<sup>10</sup>

The impact of anemia on other medical complications on mothers and newborns such as congestive heart failure and kidney failure, low and high hemoglobin concentrations during pregnancy can increase the risk of stillbirth.<sup>13</sup> Physiological conditions will impact a person's psychological condition, which can lead to stress and if it lasts long, it affects self-esteem.<sup>14-20</sup>

Anemia in pregnancy has a significant impact on the health of the fetus and mother. Adverse effects of anemia in pregnancy include an increased risk of maternal and fetal morbidity and mortality, preterm delivery, and low birth weight, a 500-fold increased risk of maternal, perinatal, and infant mortality in pregnant women with severe anemia as many as 4.9 Anemic pregnant women die easily due to obstetrical bleeding and puerperal infections which are important causes of maternal death in developing countries. Severe anemia is an important contributor to maternal mortality through the development

of heart failure, especially around delivery time. Therefore, prevention of anemia will help reduce the high maternal mortality rate

## CONCLUSION

### Conclusion

Anemia is a serious problem. One of the causes of the high maternal mortality rate is bleeding closely related to anemia. Therefore, health workers need to know the supporting factors for anemia in pregnant women, including age, educational status, gestational age, economic status, multiple pregnancies, adherence to consuming Fe tablets, malaria, and hookworms. It is hoped that by knowing these factors, health workers can provide excellent services according to the community's needs.

### Recommendation

Based on this scoping review, the authors recommend that health workers continue counseling about anemia. In addition, it also continues to provide excellent service to the community, especially pregnant women when carrying out pregnancy checks. As well as inviting other figures who play a role in the community to empower the community's economy to reduce the incidence of anemia. Of the various factors that influence anemia, it is also necessary to recommend implementing affordable contraceptive methods available at all levels of health care. In addition, it is also necessary to improve education and economic status.

A gap was found between the review results, namely the results of the study, including that most of the respondents were pregnant women and did not involve their husbands and health workers. In addition, most of the anemia research is conducted in developing countries, this is because several factors become problems in developing countries, such as the level of economic status and education which is still low.

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