

Anemia And Associated Risk Factors Among Pregnant Women: A Systematic Literature Review

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ABSTRACT

Anemia in pregnancy is a serious condition that has the potential to contribute to morbidity and mortality in both mother and baby. It is very important to explore the risk factors that cause anemia in pregnancy, so that effective prevention strategies can be taken as soon as possible. The aim to systematically examine the results of studies regarding the factors of anemia in pregnancy. Method of research PRISMA guidelines were followed. Three databases were used in the search for articles, PubMed, ScienceDirect, and Wiley Online Library which were searched from 10 May to 13 June 2023. The selected articles were limited to articles published in the last 5 years (2019-2023). A total of 45 articles were retained for full-text assessment, eligibility criteria for study inclusion/exclusion were applied and 23 articles were excluded leaving 18 cross-sectional studies and 4 case controls for review. Based on the 22 reviewed articles, 16 factors were found to be associated with anemia in pregnancy. Low dietary diversity score ($DDS \leq 3$), consumption of coffee/ tea immediately after meals, multiparity, live in a rural area, birth interval < 2 years, intestinal parasite infection, low consumption of vegetables and fruit (≤ 3 times/ week), frequency of meals < 3 times/ day, low income, MUAC < 23 cm, advanced gestational age, age 15-25 years, insufficient or irregular iron supplements, malaria, history of abortion and inadequate intake of iron-rich foods. Conclusion of the several factors found in this review, most of them are preventable and controllable factors. Health care providers, health workers and pregnant women must understand these factors, so they can better prevent and detect anemia in pregnancy.

Keywords: Anemia, Pregnancy, Related Factors, Evidence

INTRODUCTION

According to WHO (World Health Organization) anemia is a serious global public health problem, especially for children, girls and adolescent women who are menstruating, pregnant women and postpartum women. Estimated prevalence of anemia according to WHO is 40% of children aged 6-59 months, 37% of pregnant women, and 30% of women aged 15-49 years worldwide suffer from anemia (WHO, 2020). Anemia in pregnancy has been shown to be a risk factor that independently provides many adverse outcomes for both mother and baby, such as postpartum hemorrhage, bleeding during delivery, caesarean section, hysterectomy, blood transfusion, premature birth, and infectious diseases. (Harrison et al., 2021). This directly threatens the health of about 32 million pregnant women worldwide. Especially in developing countries, about 56% of pregnant women are affected (Stevens et al., 2013 ; Kumera et al., 2018).

Improving the condition of anemia in pregnancy is very important to do to reduce the risk of maternal and infant mortality and the serious complications that accompany it. Although many studies have been conducted in the last two decades and several national programs have been implemented to prevent anemia in pregnancy, the prevalence of anemia in pregnancy remains high, especially in developing countries (Liyew et al., 2021 ; Zhang et al., 2022). It is very important to explore the risk factors that cause anemia in pregnancy, so that effective prevention strategies can be adopted as soon as possible. However, several studies have shown that the risk factors for anemia in pregnancy are still quite controversial. For example, findings from (2023) Lee (2023) show that consumption of coffee or green tea is not significantly related to anemia, but is related to ferritin levels ($P=0.023$), but research findings by Kumera et al., (2018) show that coffee consumption is a contributing factor significantly associated with anemia in pregnancy (AOR = 2.91; 95% CI: 1.63, 8.78).

Several findings indicate that iron deficiency factors are believed to be the most common cause of anemia in pregnancy (Warner & Kamran, 2023 ; Miller, 2013). Therefore the World Health Organization (WHO) recommends that iron supplements be given to

pregnant women who have iron reserves of 30-60 mg per day and for pregnant women who do not have iron reserves of 120-140 mg per day (Amanah *et al.*, 2019). Conversely, there are findings showing that taking iron supplementation does not significantly reduce the incidence of anemia in pregnancy (Abdella *et al.*, 2020). It can be concluded that, different findings on the same exposure factors pose obstacles to the prevention of anemia in pregnancy and public health decisions further play an important role in this respect.

The health sector needs more definitive evidence about the risk factors for anemia in pregnancy, especially from nutritional factors. Therefore, this study will systematically summarize the nutritional risk factors associated with anemia in pregnancy, the results of this study can be a reference for preventing anemia in pregnancy in the future.

METHOD

This research study is a systematic literature review that identifies, selects, and assesses research systematically to answer questions that are clearly formulated. In selecting articles, the researcher referred to PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses). The PRISMA flowchart is an evidence-based minimum set of items intended to assist scientific authors in reporting various systematic reviews and meta-analyses, primarily used to assess the benefits and harms of a health care intervention.

Defining and Aligning Research Objectives and Questions

This review is guided by the question "What are the factors associated with anemia in pregnancy?" This study is interpreted as a research synthesis that aims to map the literature on the topic of what factors are associated with anemia in pregnancy.

Developing and Aligning Inclusion Criteria with Research Questions

This study uses the PICOS Framework (Population, Intervention, Comparison, Outcome, Study Setting) in organizing and finalizing the focus of the study and determining inclusion and exclusion criteria. The focus of the search for articles in this review is quantitative research, PICOS is considered appropriate for use PICO Framework

Tabel 1. PICO Framework

<i>PICOS criteria used in the scoping review</i>	
Population	<i>Pregnant women</i>
Interventions	<i>Report of at least one exposure factor associated with anemia in pregnancy</i>
Comparison	<i>NA</i>
Outcome	<i>Anemia in pregnancy. The diagnostic criterion is hemoglobin level ≤ 11 g/dL.</i>
Study Design	<i>Case-control, cohort, and cross-sectional studies.</i>

Inclusion criteria

Research article, fulltext in english, the object of research is humans (pregnant women), publications in the last five years (2019-2023).

Exclusion Criteria

Studies conducted on experimental animals, review articles, opinion articles, conference abstracts, case reports, and unpublished data were also excluded from this study.

Relevant literature search strategy

In the article search strategy, researchers only focus on peer-reviewed articles using several databases. The selected articles are limited to articles published within the last 5 years (2019-2023). To identify articles that are relevant to the research objectives, researchers use three databases to obtain sources of evidence, namely Pubmed, Wiley Online Library, and ScienceDirect. All articles obtained from the three databases were then exported and organized using the Zotero reference manager application. Searching for articles and the information needed is also done by scanning the list of references from relevant articles, as well as making contact with the author of the article if necessary. Article searches through the database were carried out from May 10 to June 13, 2023.

An approach of taking a combination of free words and subject words is adopted. The following terms were combined to produce the search term: ((anemia in pregnancy OR gestational anemia OR (pregnancy OR pregnant) AND anemia)) AND (risk factors OR influence factors OR factors OR related factors).

Selection of Sources of Evidence (Screening)

In conducting the screening is carried out in two stages, the first stage is to screen the abstract then the second stage is followed by screening the full article. At each stage, researchers screen independently to select potentially relevant sources of evidence.

Data Mapping Process

The data mapping process was carried out by two independent reviewers and started with trials of two selected articles as was done in the screening process to equalize perceptions between reviewers and develop an initial data mapping form if necessary. The initial trial form was adopted from the charting data guide for publication by the Joanna Briggs Institute (Aromataris E, 2020), with minor changes to suit the research objectives in this review. The initial form contained data abstractions regarding the title of the study, research objectives, population and study sample size, inclusion and exclusion criteria for research subjects, research methods, case treatment (risk factors for anemia in pregnancy), comparative treatment, and study results.

Article Selection

Article selection was carried out by combining all articles from the search results in the three databases, which were then described using the PRISMA flowchart. PRISMA is considered appropriate because its use can improve the quality of publication reporting. The process of selecting articles is described through the following PRISMA flowchart:

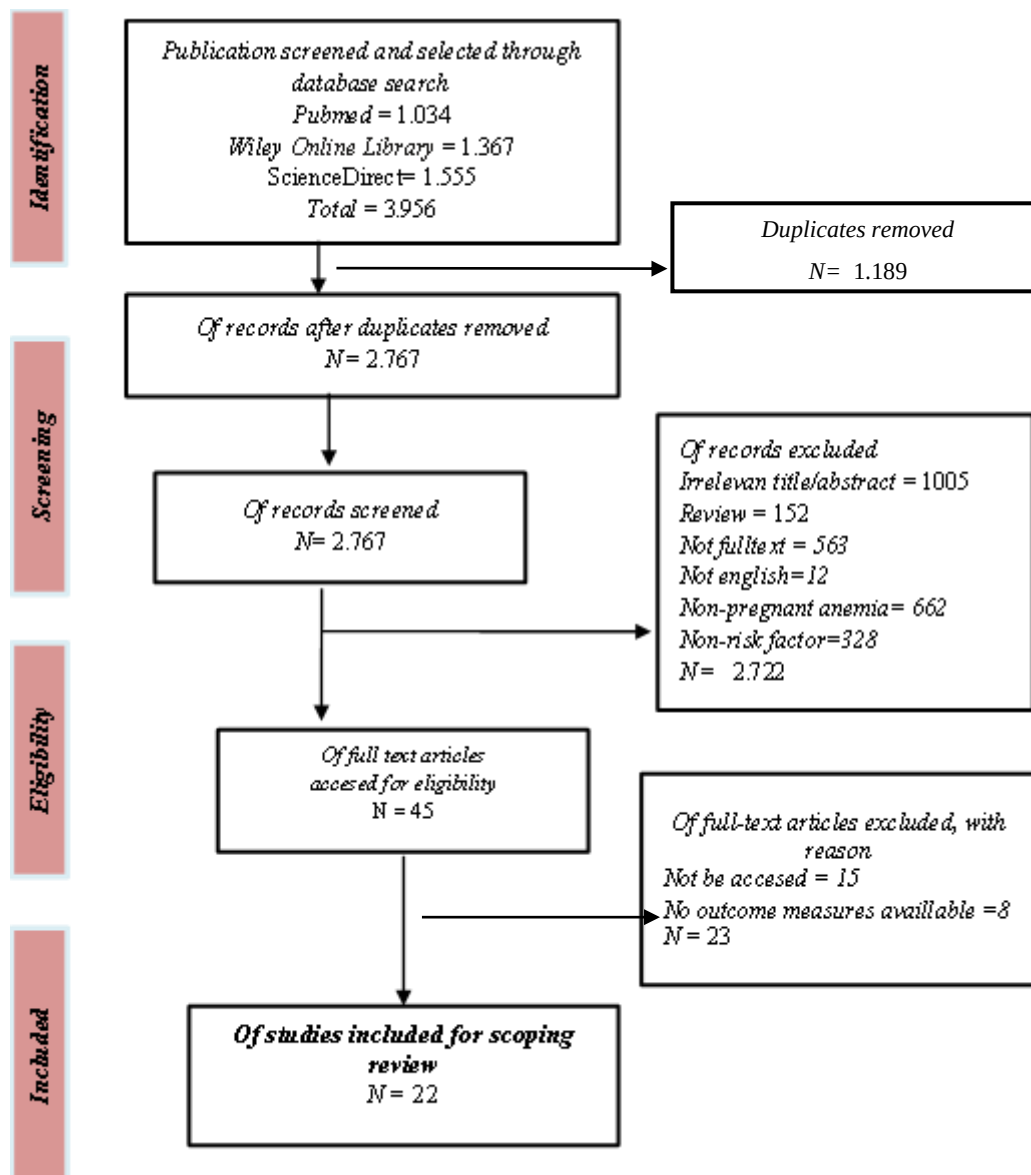


Figure 1. PRISMA Flowchart

Article Quality Assessment (Critical Appraisal)

Critical appraisal is used to assess the quality of the articles used. The tools chosen to assess quality are Joanna Briggs tools from the Joanna Briggs Institute (JBI). At the critical appraisal stage there are 22 articles to be reviewed. Most of the articles used cross sectional (18 articles) and case control (4 articles) research designs. Each research method has a different critical appraisal checklist. Assessment is given a value or answer 'yes', 'no', or 'unclear'. In assessing the quality of the articles, the researcher determined that articles that

had an assessment or yes answer $\geq 50\%$ were categorized as good quality articles, articles with more than 50% "no" or "unclear" answers were said to be of poor quality and then excluded. Articles with yes answers $< 50\%$ (grade C), 50-80% (grade B), score > 80 (grade A). After the critical appraisal was carried out, it was found that 18 articles had grade A, 4 articles grade B, and 6 articles grade C. So that a total of 22 articles based on the author's assessment had high research quality were selected in this review.

RESULT

Of the 45 articles retained for full-text assessment, eligibility criteria for study inclusion/exclusion were applied and 23 articles were excluded, leaving 18 cross-sectional studies and 4 case controls for review.

Table 2. Data Extraction

No	Author/ years	Country	Aim	Study design	Participants/ number of sample	Result	Grade
1	Teshome et al., (2020)	Ethiopia	To identify the determinants of anemia in pregnant women	Case control	344 pregnant women (117 cases and 227 controls)	Factors living in rural areas, history of monorrhagia, age 20-24 years, parasitic infections, and drinking tea/coffee directly after eating, are significantly associated with anemia in pregnancy.	A
2	Ayensu et al., (2020)	Ghana	Assessing the prevalence of anemia and dietary micronutrient intake in pregnant women in urban and rural areas	Cross sectional study	379 pregnant woman	- The prevalence of anemia in this study was 56.5%. The prevalence of anemia is higher among people who live in rural areas compared to people who live in urban areas. - Low dietary diversity score ($DDS \leq 3$), second trimester of pregnancy, and 15-24 years of age are significantly associated with anemia in pregnancy.	A
3	Samuel et al., (2020)	Ethiopia	To determine the influence of socio-demographic factors, Dietary diversity and other factors associated with anemia in pregnant women	Cross sectional study	423 pregnant woman	- The prevalence of anemia in this study was 18%. - Index factors of low income, low education level, low dietary diversity score ($DDS \leq 3$), inadequate intake of iron-rich foods, history of malaria infection, and multiparity are	A

						significantly associated with anemia in pregnancy.	
4	Yadav, (2019)	Nepal	To assess data on adherence of pregnant women with iron and folate supplementation and the prevalence of anemia among pregnant women, as well as factors related to anemia in pregnancy	<i>Cross sectional study</i>	345 pregnant woman	Factors of non-adherence in consuming iron folate tablets, birth spacing, history of fever, and not consuming iron-rich foods are significantly associated with anemia in pregnancy.	A
5	Pusporini et al., (2021)	Indonesia	To describe the risk factors for anemia in pregnant women.	<i>Case control</i>	138 pregnant women (46 cases and 92 controls)	Nutritional status factor with chronic energy deficiency with MUAC indicator (mid-upper arm circumference) <23.5 cm is significantly associated with anemia in pregnancy	A
6	Alreshidi & Haridi, (2021)	Saudi Arabia	Determine the prevalence of anemia and factors associated with anemia in pregnant women in urban communities	<i>Cross sectional study</i>	390 pregnant woman	Low income factors, larger family members (> 7 members), multiparity, longer menstrual cycles > 5 days, bleeding during pregnancy, rarely eat meat, habit of drinking tea after eating, history of anemia before pregnancy, is significantly associated with anemia in pregnancy.	A
7	Oyewole Oyerinde et al., (2023)	Nigeria	To assess the factors associated with anemia in pregnant women	<i>Cross sectional study</i>	295 pregnant woman	The factor score of low dietary diversity ($DDS \leq 3$), and the first antenatal visit in the second trimester, is significantly associated with anemia in pregnant women.	A

8	Sabina Azhar et al., (2021)	Bangladesh	Determining the prevalence of anemia, and associated risk factors, among pregnant women attending antenatal care in public and private hospitals in	Cross sectional study	424 pregnant woman	- The prevalence of anemia in this study was 62.5% and significantly (P<0.001) higher in subjects attending ANC at a government hospital (68.7%) than at a private hospital (55.0%). - Factors of maternal age 20-25 years, low monthly family income, multiparity, multigravida, and without iron supplements are significantly associated with anemia in pregnant women.	B
9	Kuma et al., (2021)	Ethiopia	Assessing hemoglobin levels and factors associated with anemia in pregnant women in rural communities	Cross sectional study	367 pregnant woman	Factors of frequency of eating < 3 times a day, interval between pregnancies $\leq$ 2 years, MUAC <23 cm, and coffee consumption, are significantly associated with anemia in pregnant women.	B
1	B. Berhe et al., (2019)	Ethiopia	Identify the prevalence and causes of anemia in pregnancy	Cross sectional study	304 pregnant woman	- The prevalence of anemia in this study was 7.9%. - Factors such as living in a rural area, experiencing recent blood loss, having a recent abortion and gestational age in the	B

						third trimester were statistically associated with anemia in pregnant women.	
1	Nuru Yesuf & Agegniche, (2021)	Ethiopia	Assess the prevalence of anemia and factors associated with anemia in pregnancy	Cross sectional study	286 pregnant woman	- The prevalence of anemia in this study was 20.9%. - Factors of hookworm infection, rural residence, history of malaria attack, and lack of green leafy vegetables are significantly associated with anemia in pregnancy.	A
1	Gibore et al., (2021)	Tanzania	Determine the prevalence and assess dietary habits associated with anemia in pregnant women	Cross sectional study	338 pregnant woman	- Factors of inadequate dietary diversity ($DDS \leq 3$), drinking tea or coffee with meals, frequency of meals < 3 times/day, birth spacing < 2 years and multigravida status were significantly associated with anemia in pregnancy.	A
1	Tibambuya et al., (2019)	Ghana	Assessing anemia at initiation of antenatal care and related factors among pregnant women	Cross sectional study	378 pregnant woman	- The prevalence of anemia in this study was 56% - Factors of first antenatal examination in the second and third trimesters, and not or rarely consuming eggs are significantly	B

						associated with anemia in pregnancy	
1	K. Berhe et al., (2019)	Ethiopia	Identify risk factors for anemia in pregnant women	<i>Case control</i>	600 pregnant woman (150 case dan 450 control)	- Factors of intestinal parasites (worm infection), farmer's work, drinking coffee/tea with or immediately after food every day and a low dietary diversity score ($DDS \leq 3$) are statistically significant associated with anemia in pregnant women.	A
1	Abdu et al., (2021)	Ethiopia	Assessing the prevalence and factors associated with anemia among pregnant women	<i>Cross sectional study</i>	314 pregnant woman	- The prevalence of anemia in this study was 37.9% - Factors Birth interval < 2 years , history of blood loss during pregnancy, less consumption of citrus fruits in a week, and frequency of eating < 3 times per day during pregnancy are significantly associated with anemia.	A
1	Balis et al., (2022)	Ethiopia	Determining the magnitude of anemia and related factors among pregnant women	<i>Cross sectional study</i>	456 pregnant woman	- Factors consuming tea or coffee after meals, history of menorrhagia, low household income, four living in rural areas,	A

						history of abortion, living in rural areas, birth interval < 2 years, and having more than 3 children.	
1	(Abdallah et al., 2022)	Tanzania	Assess the prevalence of anemia and identify factors associated with anemia in pregnant women	Cross sectional study	420 pregnant woman	- The prevalence of anemia in pregnant women in this study was 25.5%. - Factors of low socioeconomic status are significantly related to anemia in pregnancy	A
1	Ngimbudzi et al., (2021)	Tanzania	Assessing the prevalence and factors associated with anemia in pregnant women	Cross sectional study	418 pregnant woman	- The prevalence of anemia in pregnant women in this study was 83.5% - Third trimester gestational age factor, not consuming vegetables, eggs, and fish is significantly associated with anemia in pregnancy	A
1	Anwary et al., (2021)	Afghanistan	Identify the prevalence of anemia and factors associated with anemia in pregnant women	Cross sectional study	787 pregnant woman	- The prevalence of anemia in this study was 51% - Factors in the age group ≥30 years, living in rural areas, multiparity, and not previously using contraception were significantly associated with anemia in pregnancy.	A

2	Deriba et al., (2020)	Ethiopia	Identify predictors of nutrition-related anemia among pregnant women	<i>Case control</i>	426 pregnant woman (142 case dan 284 control)	Factors consuming tea or coffee immediately after eating, mid-upper arm circumference (MUAC) <23 cm, not consuming fruit, and a low dietary diversity score ($DDS \leq 3$) were found as determinants of anemia	A
2	Tulu et al., (2019)	Ethiopia	Identify the determinants of anemia in pregnant women	<i>Cross sectional study</i>	573 pregnant woman	Factors of low monthly income, history of menorrhagia, taking iron supplements irregularly, upper arm circumference (MUAC) <23 cm, low dietary diversity score ($DDS \leq 3$), and intestinal helminth infections were significantly associated with anemia during pregnancy.	A
2	Tan et al., (2020)	China	Investigate the prevalence of anemia and iron deficiency anemia and its risk factors	<i>Cross sectional study</i>	12.403 pregnant woman	Factors of advanced gestational age, multiple pregnancies, multiparity, low prepregnancy weight, and a history of severe nausea or vomiting during pregnancy are significantly associated with anemia in pregnancy.	A

Mapping the findings

Factors associated with anemia in pregnancy:

Table 3. Mapping of the findings

Theme	Subtheme (Factors)	Number of studies	Article
Evidence related to maternal nutritional intake or diet	Low dietary diversity score ($\text{DDS} \leq 3$)	7	Ayensu et al., (2020), Samuel et al., (2020), Oyewole Oyerinde et al., (2023), Gibore et al., (2021), K. Berhe et al., (2019), Deriba et al., (2020), Tulu et al., (2019)
	Drink coffee or tea immediately after eating	7	Teshome et al., (2020), Kuma et al., (2021), Gibore et al., (2021), K. Berhe et al., (2019), Balis et al., (2022), Deriba et al., (2020), Alreshidi & Haridi, (2021)
	Low consumption of vegetables and fruit (≤ 3 times per week)	4	Nuru Yesuf & Agegniche, (2021), Ngimbudzi et al., (2021), Abdu et al., (2021), Deriba et al., (2020)
	Frequency of daily meals < 3 times per day	3	Kuma et al., (2021), Gibore et al., (2021), Abdu et al., (2021)
	Inadequate intake of iron-rich foods	2	Samuel et al., (2020), Yadav, (2019), Ngimbudzi et al., (2021)
	Lack of or irregular iron supplements	2	Tulu et al., (2019), Sabina Azhar et al., (2021)
	MUAC (mid-upper arm circumference) < 23 cm	4	Kuma et al., (2021), Deriba et al., (2020), Tulu et al., (2019), Pusporini et al., (2021)
Evidence related to maternal status	Multiparity	5	Samuel et al., (2020), Alreshidi & Haridi, (2021), Sabina Azhar et al., (2021), Anwary et al., (2021), Tan et al., (2020)
	Residence in the countryside	5	Teshome et al., (2020), B. Berhe et al., (2019), Nuru Yesuf & Agegniche, (2021), Balis et al., (2022), Anwary et al., (2021)

	Birth interval < 2 years	4	Yadav, (2019), Gibore et al., (2021), Abdu et al., (2021), Balis et al., (2022)
	Low income	4	Samuel et al., (2020), Alreshidi & Haridi, (2021), Sabina Azhar et al., (2021), Balis et al., (2022),
	Advanced gestational age	4	Tan et al., (2020), Ngimbudzi et al., (2021), B. Berhe et al., (2019), Ayensu et al., (2020)
	Age 15-25 years	3	Teshome et al., (2020), Ayensu et al., (2020), Sabina Azhar et al., (2021)
Evidence related to previous medical history	Intestinal parasitic infection (worm infection)	4	Teshome et al., (2020), K. Berhe et al., (2019), Nuru Yesuf & Agegniche, (2021), Tulu et al., (2019)
	History of malaria	2	Nuru Yesuf & Agegniche, (2021), Samuel et al., (2020),
	Abortion history	2	B. Berhe et al., (2019), Balis et al., (2022)

Of the 22 articles reviewed, 16 factors were found to be associated with anemia in pregnancy. Low dietary diversity score ($DDS \leq 3$), consumption of coffee or tea immediately after meals, multiparity, place of residence (rural), birth interval, intestinal parasite infection (worm infection), low consumption of vegetables and fruit (≤ 3 times per week), frequency of meals < 3 times per day, low income, MUAC (mid-upper arm circumference) < 23 cm, late gestational age, maternal age 15-25 years, insufficient or irregular iron supplements, history of malaria, history of abortion and inadequate intake of iron-rich foods.

DISCUSSION

Evidence regarding nutritional intake or maternal diet

Consume coffee or tea immediately after meals

There are seven articles which show the association of consuming coffee or tea immediately after eating to an increased risk of anemia in pregnancy. This happens because high consumption of tea and coffee at mealtimes or after meals can reduce the bioavailability of iron from the foods you eat. It has been shown that drinking tea with food can decrease iron absorption by $\geq 50\%$ and can increase the likelihood of iron deficiency (Fan, 2016 ; Baig-Ansari et al., 2008).

Low diet diversity score ($DDS \leq 3$)

There are seven articles which show the relationship between a low dietary diversity score ($DDS \leq 3$) increases the risk of anemia in pregnancy. The DDS score is an independent predictor of concentration or hemoglobin level in pregnancy. Pregnant women with low consumption of dietary diversity are more likely to experience anemia than pregnant women with high dietary diversity scores. Low dietary diversity is closely related to economic status, research by Saaka *et al.*, (2017) shows a lack of dietary diversity among poor people, whose daily food consumption is mostly carbohydrates with little or no animal products, fruits and vegetables.

Mid-Upper Arm Circumference (MUAC) <23 cm

There are four articles showing the relationship between MUAC and anemia in pregnancy. The four studies showed that there was a statistically significant relationship between MUAC <23 cm as an indicator of nutritional status and anemia in pregnant women. This is because during pregnancy, there is an increased need for iron and other micronutrients. These demands result in a decrease in iron stores during pregnancy and can eventually cause anemia. Apart from its relation to the occurrence of anemia in pregnancy, the nutritional status of the mother during pregnancy is an important determinant of the health, development and well-being of the fetus in the future (Christian *et al.*, 2015 ; WHO, 2013). Upper Arm Circumference can be used as a screening tool for pregnant women, eg as a criterion for entry into a feeding programme. The guidelines state that the cut-off point for risk varies by country and ranges from 21 cm to 23 cm (Ververs *et al.*, 2013).

Low consumption of vegetables and fruit (≤ 3 times per week)

There are four articles showing the significance of the relationship between the low frequency of eating vegetables and fruit and an increased risk of anemia in pregnancy. Certain vegetables and fruits are rich in vitamins that are useful for increasing hemoglobin levels in the blood, the inability to consume vegetables can cause non-heme iron deficiency which causes iron deficiency anemia. Vitamins A and C obtained from fruits and vegetables are useful for increasing iron absorption (Li *et al.*, 2020 ; da Cunha *et al.*, 2019). In addition, vitamin A is used for the synthesis of red blood cells and immune function, the result of a deficiency of vitamin A is to cause a deficiency of hemoglobin and

cause infection which in turn causes anemia. In addition, the inability to consume fruit causes a deficiency of vitamin C which increases iron absorption where the deficiency causes anemia (Krisnanda, 2020).

Low consumption of iron-rich foods

There are three articles showing that low consumption of iron-rich foods increases the risk of anemia in pregnancy. The thing that can cause low consumption of iron-rich foods in pregnant women is knowledge. Research shows that consumption of iron-rich foods from animal sources (heme-iron) is very low compared to non-heme iron found in plant sources. Absorption of heme-iron is less affected by other dietary components of the diet than with non-haem iron. Economic factors also play a role in this matter, for example in poor rural communities, livestock are kept not for consumption but for economic purposes (Adjei-Banuah et al., 2021).

Frequency of daily meals < 3 times per day There are three articles which show a relationship between eating frequency <3 times a day in increasing the risk of anemia in pregnancy. This can be explained by the fact that increasing the frequency of meals during pregnancy will increase the likelihood of consuming iron-rich foods thereby reducing the risk of anemia (Lebso et al., 2017).

Inadequate consumption of iron supplements

There are two articles showing a relationship between adherence to consumption of iron tablets and the occurrence of anemia in pregnant women. These two studies showed a statistically significant relationship between adherence to consumption of iron tablets during pregnancy and the occurrence of anemia, especially in the later trimesters. This finding is consistent with Falahi *et al.*, (2011) which stated that pregnant women who regularly consume 60 mg iron tablets per day experience significantly lower anemia compared to the placebo group. Then research by Taner *et al.*, (2015) showed that pregnant women who consumed iron tablets for less than 3 months had a very significant association with the occurrence of anemia in the third trimester of pregnancy.

Evidence related to maternal factors

Live in a rural area

There are five articles that show the relationship between living in rural areas and the risk of anemia in pregnancy. This finding is supported by several studies which suggest that pregnant women living in rural areas are more likely to be affected by societal beliefs about poor feeding practices, and have lower access to nutrition education and counseling programs (CSA & ICF, 2012). In general, unequal allocation of resources can lead to inequality in women's health outcomes between rural and urban settlements. This suggests that maternal malnutrition can decrease by improving the quality of midwifery care during pregnancy (Darnton-Hill & Mkpuru, 2015).

Multiparity

There are five articles which show that multiparity factors are significantly related to anemia in pregnancy. Pregnant women who give birth at least once are four times more likely to develop anemia than pregnant women with their first pregnancy. This finding correlates with previous studies which state that the risk of decreased hemoglobin concentration in multiparas is greater than that of nulliparas (Gebremedhin et al., 2014). This shows that with an increase in the number of births, the possibility of nutrient depletion increases so that the possibility of anemia is higher.

Low income

There are four articles that show the relationship between low income levels and the risk of anemia in pregnancy. Low income is a factor in the occurrence of anemia in pregnancy because low income is related to the compliance of pregnant women to consume iron tablets and iron-rich food sources (Yadav, 2019). Research by Nisar et al., (2014) suggests that women who are included in the lowest household wealth index group have a higher chance of not taking iron tablets. This is because mothers with a good household wealth index have stronger financial ability to pursue iron tablets during pregnancy (Taye et al., 2015; Habib et al., 2009).

Birth interval < 2 years

There are four studies that show a significant relationship between short birth spacing and an increased risk of anemia in pregnancy. Pregnancy is associated with an increased need for nutrients, such as iron and folate, which are required to increase red blood cell mass, expand plasma volume, and allow growth of the fetus and uteroplacental organs. Lactation

presents a continuation of this request. The short interval between pregnancies provides insufficient time for women to replenish their nutritional reserves before the next pregnancy, which increases the risk of maternal anemia and adverse pregnancy outcomes (Mruts et al., 2022).

Advanced gestational age

There are four articles that show a significant relationship between advanced gestational age and anemia in pregnancy. This finding is in accordance with the study of Milman et al., (2017) which suggested that the increase in anemia peaked in the middle to the end of the third trimester.

Age 15-25 years

There are three articles which show that the highest prevalence of anemia occurs in pregnant women with an age range of 15-25 years, and is statistically significant. This is consistent with the findings of Gautam et al., (2019), who in their research found that overall pregnant women, around 41% of women aged 15-25 years experienced anemia.

Evidence related to the mother's medical history

Worm infection

There are four articles showing the link between helminth infection and an increased risk of anemia in pregnancy. This finding is supported by several studies which say that apart from nutritional factors, lack of vitamins (vitamins B9, B12, and A), there is a history of diseases related to the occurrence of anemia in pregnancy such as inflammation, infectious diseases (such as malaria, hookworms which are transmitted through soil, especially hookworm infections, HIV, cancer, and tuberculosis), as well as genetic or acquired defects in hemoglobin synthesis, and red blood cell production and survival (Lopez et al., 2016; Camaschella, 2015).

Malaria

The review shows that there are two articles that show a significant relationship between a history of malaria and an increased risk of anemia in pregnancy. Malaria is one of the factors that causes and exacerbates anemia in pregnancy, this occurs due to hemolysis or breakdown of red blood cells which is affected by the malaria parasite which drives an increased demand for folate in pregnancy (White, 2018).

Abortion history

There are two articles that show a link between history of abortion and anemia in pregnancy. This is due to the factor of blood loss during abortion, according to research in South western Ethiopia, history of abortion is significantly associated with anemia (Zekarias et al., 2017). This can be caused by increased blood loss which depletes iron stores causing the need for extra iron than usual (Tadesse et al., 2017).

CONCLUSION

The high prevalence of anemia and the impact of anemia in pregnancy on maternal and neonatal mortality and morbidity requires a systematic summary of the risk factors. Evidence from 22 studies, Low dietary diversity score ($DDS \leq 3$), consumption of coffee or tea immediately after meals, multiparity, place of residence (rural), birth interval, intestinal parasite infection (worm infection), consumption of vegetables and fruit Low income (≤ 3 times per week), frequency of meals < 3 times per day, low income, MUAC (mid-upper arm circumference) < 23 cm, gestational age, maternal age 15-25 years, insufficient or irregular iron supplementation, history of malaria, history of abortion and inadequate intake of iron-rich foods, these 16 exposure factors are all risk factors for Anemia in Pregnancy. Health care providers, health workers and pregnant women must understand the above factors in order to carry out prevention and early detection better anemia in pregnancy.

Strengths and Limitations

Strength

1) As a review conducted systematically in summarizing the risk factors for anemia in pregnancy, this study can be used as the best evidence for prevention of anemia in future pregnancy. 2) According to the results of critical assessment, we found that the quality of the articles from 22 studies had 18 high quality articles (grade A), and 4 articles of medium quality (grade B)

Limitations

1) The included studies are all from developing countries (mostly Ethiopian countries, so these findings cannot apply to all countries. 2) The articles included in this review are only in English, so there is a potential for language bias.

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