EFFECTS OF COFFEE AND TEA CONSUMPTION AND DIETARY DIVERSITY ON ANEMIA IN PREGNANT WOMEN: A META-ANALYSIS

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ABSTRACT

Background: Gestational anemia has become a significant global burden. Anemia has multiple risk factors, including food consumption. The most important thing is hypotesized to be the lifestyle-based risk factors. This study aimed to determine the effect of coffee and tea consumption and dietary diversity on anemia in pregnant women.
Subjects and Methods: This study was a meta-analysis. Online articles from 2011 to 2021 were searched from databases, including PubMed, MEDLINE, and Google Scholar, from 2011 to 2021. The PICO was as follows. Population: pregnant women. Intervention: coffee consumption and tea and diet diversity. Comparison: without coffee and tea consumption and dietary diversity. Outcome: anemia. The data were analyzed using RevMan 5.3 software.
Results: A total of 9 articles from Ethiopia and Tanzania were included in the meta-analysis. Pregnant women who frequently consumed coffee and tea after meals had a higher risk of developing anemia than those who did not (OR=1.63; 95% CI= 0.34 to7.78; p=0.53). Likewise, pregnant women with low scores on the diversity of foods had a higher risk of developing anemia (OR=4.16; 95% CI= 2.35 to 7.38; p= 0.001).
Conclusion: The habit of consuming tea and coffee after eating and the low score of the diversity of foods can increase the risk of anemia in pregnant women.

Keywords: coffee-tea, diet diversity, anemia, pregnant women

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BACKGROUND

Anemia is a public health problem that has affected a third of the world's population and is more common in young, middle- and low-income women and pregnant women (Kumar et al., 2013). Globally anemia affects approximately 32.4 million (38.2%) pregnant women. This is a public health problem that occurs in South-east Asia (48.7%) and Africa (46.3%) (Abay et al., 2017; WHO, 2015). Anemia that occurs during pregnancy is a major cause of maternal morbi-dity and mortality in developing countries, and has consequences for both mother and fetus (Salhan et al., 2012). It is estimated that anemia causes more than 115,000 maternal deaths and 591,000 perinatal deaths globally per year (Balarajan et al., 2011). Severe levels of anemia (<7

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g/L) during pregnancy can cause complications for the mother and fetus, namely increasing the risk of premature birth, low birth weight, intrauterine fetal death, neonatal death, maternal and infant mortality (Ayano, 2018).

The causes of anemia in pregnant women are very complex, including infections (malaria and worm infestations), nutritional deficiencies (iron, folic acid, and vitamin B12), and genetic factors (hemoglobinopathy) (Balarajan et al., 2011; Broek, 2011). 1998; Tolentino and Friedman, 2007). Women often become anemic during pregnancy due to the increased need for iron and other vitamins in the body. It is estimated that blood volume increases by about 50 percent during pregnancy, so the amount of blood plasma rises disproportionately greater. This causes dilution of the blood, causing the hemoglobin concentration to fall, with the lowest hemoglobin concentration between the 25th and 30th weeks of gestation (Salhan et al., 2012).

Anemia has multifactorial causes, namely complex interactions between nutrition, infectious diseases, and other factors (Balarajan et al., 2011). In developing countries, pregnant women are prone to anemia due to low socioeconomic conditions, poor nutritional intake, repeated infections, frequent pregnancies, blood loss during menstruation, lifestyle, and low behavior in seeking services or health information related to anemia (Getahun et al., 2017; Karaoglu et al., 2010; Khan et al., 2006; Tadesse et al., 2017). Pregnant women with low (≤3) and moderate (4–6) food diversity scores are more at risk of experiencing anemia when compared to pregnant women who have food diversity scores >6 (Tulu et al., 2019).

Monitoring health problems and their determinants is very important to develop effective interventions (Muhangi et al., 2007). Pregnant women are more susceptible to stress, which can affect the state of fetal growth in the womb (Handayani et al., 2020). It is important to identify risk factors that contribute to the increasing incidence of anemia in pregnant women for prevention efforts and to implement global nutrition targets to reduce the prevalence of anemia in pregnant women by half (WHO, 2014).

However, the limited number of studies is a challenge in itself to reduce the incidence of anemia, especially in developing countries such as Indonesia. Therefore, this study aims to determine the risk factors for anemia, one of which is the influence of the habit of consuming coffee and tea after eating and the diversity of diets on anemia in pregnant women.

SUBJECTS AND METHOD

1. Study Design

This research is a systematic review and meta analysis. The articles used in this study were obtained from several databases, namely PubMed, MEDLINE, and Google Scholar between 2011 and 2021. The selection of articles was carried out using PRISMA flow diagrams. The keywords to search for articles are as

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follows “anemia”, “coffee-tea”, “diet diversity”, “pregnant women”, and “risk factors”.

2. Inclusion Criteria

The inclusion criteria of this study were: full-text articles with a cross-sectional study design for the dependent variable coffee and tea consumption, as well as case-control for the variable low in the diversity score of diet. research subjects are pregnant women, research using multivariate logistic regression analysis.

3. Exclusion Criteria

The exclusion criteria for this study were: articles in languages other than English and Indonesian, incomplete or unavailable research data, articles published before 2011.

4. Operational Definition of Variables

Anemia in pregnancy is defined as a hemoglobin level below 11 gm/dl. Coffee and tea consumption variables were defined as pregnant women who consumed coffee and/tea after meals. The low food diversity score is the average dietary diversity scores (DDS) below three.

5. Variable

The dependent variable is anemia. The independent variables were coffee and/tea consumption and dietary diversity scores.

6. Instrument

Search articles using online databases (PubMed, MEDLINE, and Google Scholar). The process of searching and filtering articles using a Prism diagram (chart 1). Articles included in this study must meet the inclusion criteria and have been reviewed using a critical appraisal in accordance with the research design of each article.

RESULTS

1. Characteristics of Study Subjects

There are a total of 129 articles search results from the online databases PubMed, MEDLINE, and Google Scholar using the keywords "anemia", "coffee-tea", "diet diversity", "pregnant women", and "risk factors" by choosing the year of publication between 2011 -2021. There were a total of 14 articles that met the inclusion criteria and were processed in qualitative and quantitative synthesis. A total of 9 articles explain the effect of coffee and tea consumption, while 7 articles explain the effect of low dietary diversity scores on the incidence of anemia among pregnant women. There are 6 articles using a case-control study design and 8 articles using a cross-sectional study. Of the 14 articles that have been selected, 5 of them are from the Public Library of Science (PLOS) journal.

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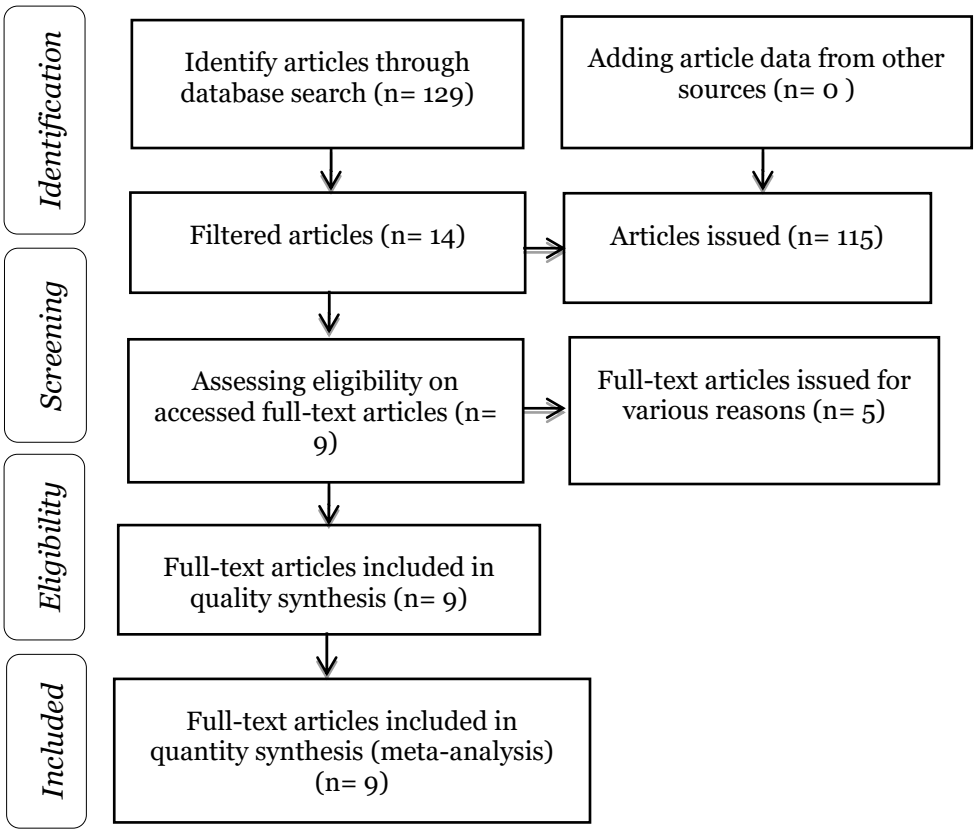

Figure 1. PRISMA Diagram

The characteristics of the articles included in the qualitative synthesis are described in table 1. The number of references and journal sources can be seen in table 2. The data for the extraction of articles can be seen in table 3. There are 2 risk factors that were analyzed using the review manager application.

1. The effect of coffee and tea consumption on the incidence of anemia in pregnant women

Pregnant women who have the habit of frequently consuming coffee or tea after eating have a 1.63 higher risk of anemia compared to pregnant women who do not have these habits, although the results were not statistically significant (p=0.06). The value of heterogeneity (I^2) in this analysis is 96%, so the authors use a random effect in determining the results (Figure 1).

Based on the results of the funnel plot (Figure 2), the results of the meta-analysis do not show publication bias due to the symmetrical distribution of the circles and there are circles that touch the center line of the graph.

2. The effect of low food diversity score on the incidence of anemia in pregnant women

Pregnant women who have low scores on dietary diversity have a risk of developing anemia by 4.16 higher than those who have moderate and high scores. These results were statistically significant (p=0.001). The heterogeneity value (I^2) in this analysis was 53%, so the authors used a random effect in determining the

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results (graph 3). Based on the results of the funnel plot (graph 4), the results of the meta-analysis do not show publication bias due to the symmetrical distribution of circles.

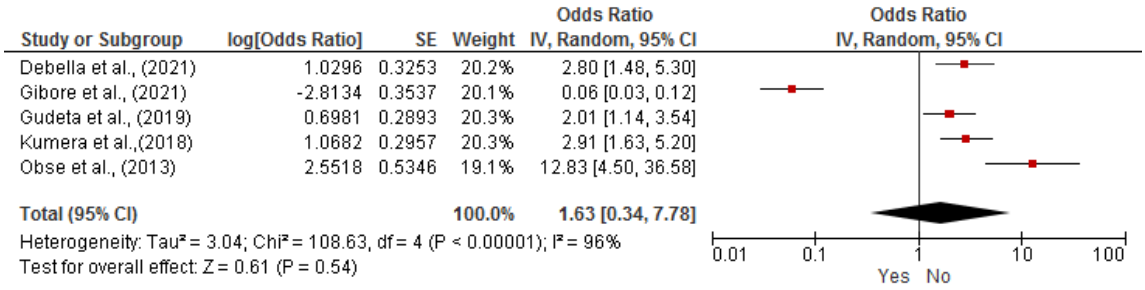

Figure 1. Forest plot of coffee and tea consumption variables

The forest plot in Figure 1 shows that pregnant women who consume coffee and tea have a 1.63 times risk of developing anemia compared to pregnant women who do not consume coffee and tea (aOR= 1.63; 95% CI= 0.34 to 7.78), and the results are statistically significant. significant (p= 0.54). The heterogeneity of the research data showed I^2= 96% so that the distribution of the data was declared heterogeneous (random effect model).

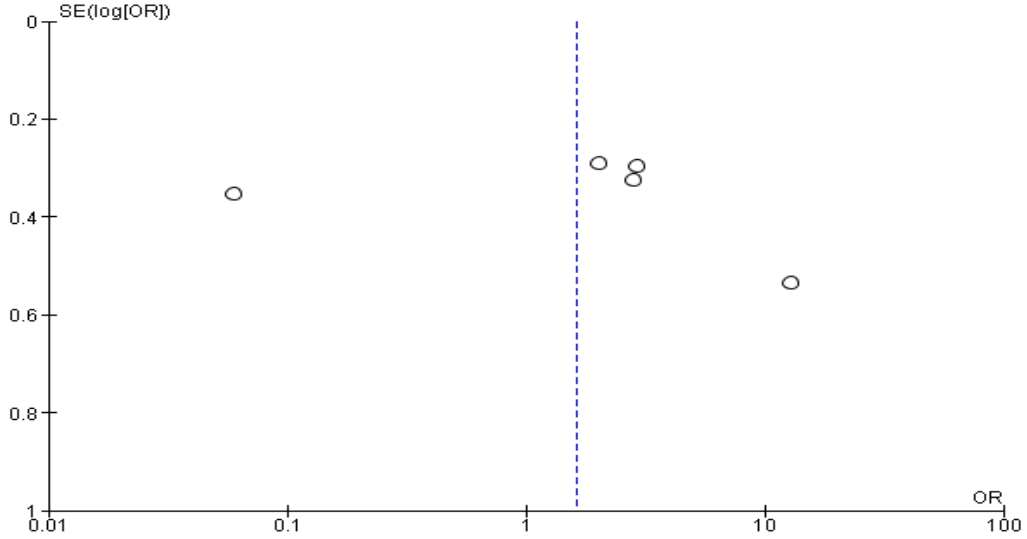

Figure 2. Funnel plot of coffee and tea consumption variables

The funnel plot in Figure 2 shows publication bias with an overestimated effect characterized by an asymmetric distribution between the right and left plots. There is one plot on the right and four plots on the left. The plot on the right side of the graph has a standard error (SE) between 0.2 and 0.4. The plot on the left side of the graph has a standard error (SE) between 0.2 and 0.6.

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Table 1. The Effect of Coffee and Tea Consumption and Dietary Diversity on Anemia in Pregnant Women

No	Author (year)	Country	Study design	Number of sample	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (CI 95%)
1	Deriba et al., (2020)	Ethiopia	Case-control	426 pregnant women (142 cases and 284 controls)	Pregnant women	Low diet diversity score	High diet diversity score	Anemia	3.29 (1.83 to 5.90)
2	Berhe et al., (2019)	Ethiopia	Case-control	600 pregnant women (150 cases and 450 controls)	Pregnant women	Low diet diversity score	High diet diversity score	Anemia	3 (1.5 to 5.5)
3	Tulu et al., (2019)	Ethiopia	Case-control	191 anemic pregnant women and 382 non-anemic pregnant women	Pregnant women	Low diet diversity score	High diet diversity score	Anemia	12.30 (4.64 to 32.72)
4	Ebuy et al., (2017)	Ethiopia	Case-control	264 pregnant women (88 cases and 176 controls)	Pregnant women	Low diet diversity score	High diet diversity score	Anemia	3.23 (1.19 to 8.71)

Table 2. The Effect of Coffee and Tea Consumption and Dietary Diversity on Anemia in Pregnant Women

No	Author (year)	Country	Study Design	Total of Subjects	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (CI 95%)
1	Kumera et al.,(2018)	Ethiopia	Cross-sectional	234 pregnant women	Pregnant women	Consuming tea and coffee after eating	Do not consume tea and coffee after eating.	Anemia	2.91 (1.63 to 8.78)
2	Gudeta et al., (2019)	Ethiopia	Cross-sectional	1871 pregnant women	Pregnant women	Consuming tea and coffee after eating	Do not consume tea and coffee after eating.	Anemia	2.01 1.14 to 3.55)
3	Obse et al., (2013)	Ethiopia	Cross-sectional	374 pregnant women	Pregnant women	Consuming tea and coffee after eating	Do not consume tea and coffee after eating.	Anemia	12.83 (4.5 to 28.9)
4	Gibore et al., (2021)	Tanzania	Cross-sectional	338 pregnant women	Pregnant women	Consuming tea and coffee after eating	Do not consume tea and coffee after eating.	Anemia	0.06 (0.03 to 0.13)
5	Debella et al., (2021)		Cross-sectional	405 pregnant women	Pregnant women	Consuming tea and coffee after eating	Do not consume tea and coffee after eating.	Anemia	2.8 (1.48 to 5.61)

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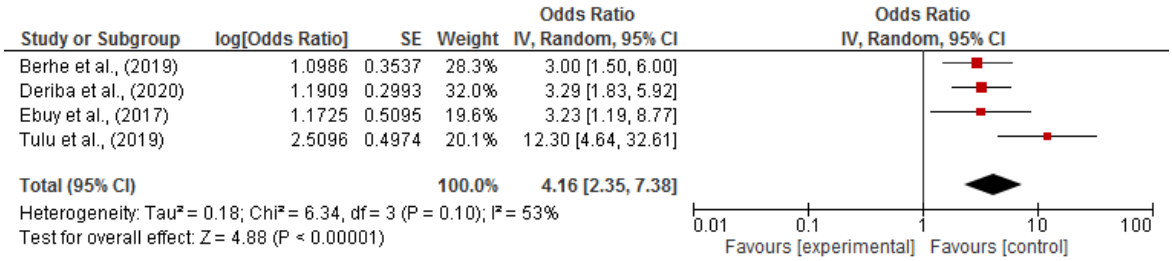

Figure 3. Forest plot variable low score of diet diversity

The forest plot in Figure 3 shows that pregnant women with low dietary diversity scores had 4.16 times the risk of developing anemia compared to pregnant women with high dietary diversity scores (aOR = 4.16; 95% CI = 2.35 to 7.38), and these results are generally statistically significant ($p<0.001$). The heterogeneity of the research data shows $I^2= 53\%$ so that the distribution of the data is declared heterogeneous (random effect model).

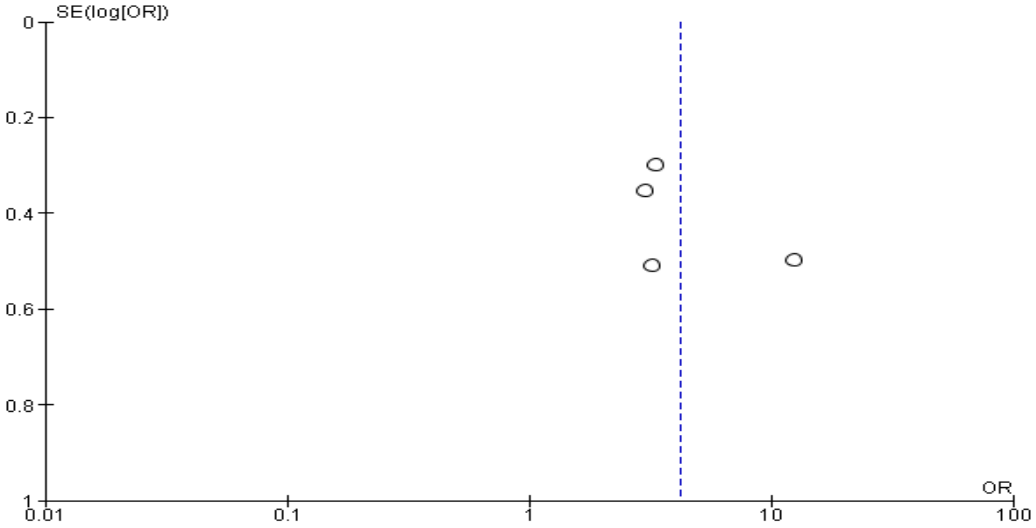

Figure 4. Funnel plot of the low score on the diversity of diets

The funnel plot in Figure 4 shows publication bias with an under-estimate effect characterized by an asymmetric distribution between the right and left plots. There are three plots on the right and one plot on the left. The plot on the right side of the graph has a standard error (SE) between 0.2 and 0.6. The plot on the left side of the graph has a standard error (SE) between 0.4 and 0.6.

DISCUSSION

The results of this meta-analysis show that there is a relationship between the habit of consuming coffee and tea after eating with the incidence of anemia in pregnant women. This is in accordance with the statement by Muñoz et al. (1988) who explained that maternal coffee intake during pregnancy can worsen anemia in the mother. The study by Sung et al.

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(2018) explained that coffee consumption was associated with lower serum ferritin levels in Korean adults. Ferritin is a protein that plays a role in storing iron. A decrease in ferritin levels can indicate a decrease in iron stores, and can be caused by a related nutritional deficiency condition (Putri, Nindya and Probosari, 2016).

Coffee and tea contain tannins which have the potential to interfere with iron absorption (Savolainen 1992). Coffee affects the bioavailability of iron and its potential as an absorption inhibitor tends to exacerbate anemia when physiological needs are increased or when dietary iron intake is essential (Food & Agriculture Org. 1988). A study by Fan 2016) has proven that drinking tea with or after meals can decrease iron absorption by up to 50%.

The results of the meta-analysis in this study stated that pregnant women who had low dietary diversity scores were more prone to developing anemia during their pregnancy. These results are in accordance with Gebremedhin and Enquselassie (2011) which states that respondents with low dietary diversity scores during pregnancy have a much higher risk of anemia. This is in line with the results of a study by Saaka (2015), that a high dietary diversity score is associated with a reduced risk of anemia in the third trimester of pregnancy. Low dietary diversity causes mineral and vitamin deficiencies that can affect the status of iron levels in the body. Given that during pregnancy there is an increase in the need for energy and nutrients which can be met by increasing the frequency of various meals (Berhe et al., 2019; Makhoul et al., 2012).

The conclusion of this study is that pregnant women who have a habit of drinking tea or coffee after eating and for mothers who have low scores on the diversity of daily food consumption are at risk of developing anemia during pregnancy. Increased education to mothers about correct and varied dietary habits can be delivered by health workers during antenatal visits. The diversity of countries of origin of articles in this meta-analysis is still limited to 2 countries. Therefore, the authors hope that further meta-analysis can expand the coverage of the country of origin of the article as well as other risk factors that influence anemia in pregnant women.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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