Meta Analysis of the Relationship between Tea Drinking Habits and the Incidence of Anemia in Pregnant Women

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ABSTRACT

Background: Anemia is a nutritional problem that needs attention and is one of the public health problems in Indonesia. One of the causes of anemia in pregnant women is the consumption of tea, where tea contains polyphenols which can inhibit the absorption of iron. The purpose of this study was to analyze the available evidence related to the relationship between tea drinking habits and the incidence of anemia in pregnant women.

Subjects and Method: This study uses a systematic review and meta-analysis with PICO, namely, population= pregnant women. Intervention= drinking tea. Comparison= don't drink tea. Outcome = incidence of anemia. Article searches were conducted using electronic databases such as Google Scholar and PubMed between 2013 and 2022. The keywords used were: [("drinking tea" OR "tea consumption") AND ("anemia" AND "pregnancy") OR ("pregnant" women")]. The inclusion criteria used were full paper articles with observational studies (cross-sectional), multivariate analysis with adjusted Odd Ratios (aOR) to measure the estimated effect. The article search results are listed in the PRISMA diagram and analyzed using the Review Manager 5.3 application.

Results: A total of 7 articles from Ethiopia, Somalia, Nepal, and Saudi Arabia were selected to be carried out in a systematic review and meta-analysis. The data collected showed that pregnant women who had the habit of drinking tea could increase the risk of anemia 1.94 times compared to pregnant women who did not drink tea (aOR=1.94; 95% CI=1.10 to 3.43; p=0.020).

Conclusion: Pregnant women who have a habit of drinking tea can increase the risk of anemia.

Keywords: Pregnant women, drinking tea, and anemia

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BACKGROUND

Pregnancy is a critical period, where good nutrition is an important factor affecting the health of mothers and children (Pritasari et al., 2017). Maximum fetal formation requires proper nutrition during pregnancy. A good diet is very influential on nutritional adequacy during pregnancy and to reduce the risk of disability in infants (Simbolon et al., 2018).

Malnutrition that occurs during pregnancy will cause early damage to intelligence, health, school ability, brain development, and permanent production power that cannot be repaired (Pritasari et al., 2017). Pregnant women must increase the

amount and type of food to meet the needs of the mother, the fetus in the womb, and to produce breast milk (Ministry of Health RI, 2014).

Lack of intake of macronutrients (carbohydrates, protein, and fat) and micronutrients (folic acid, iron, zinc, calcium, iodine, etc.) can cause nutritional and health problems for mothers and babies (Pritasari et al., 2017). One of the problems related to this nutritional status is anemia in pregnant women (Ministry of Health RI, 2014).

Anemia is a nutritional problem that needs attention and is one of the public health problems in Indonesia. Based on Riskesdas 2018, the percentage of pregnant women who experience anemia is 48.9%. This means that about 5 out of 10 pregnant women in Indonesia suffer from anemia (Kemenkes RI, 2020). Pregnant women who are anemic have an unfavorable impact on their bodies, namely the growth and development of the fetus in the womb is not optimal and has the potential to cause pregnancy and childbirth complications, and even maternal and child mortality (Kemenkes RI, 2020).

Pregnant women are called anemia if the hemoglobin content is <11 g/dL. Iron is one of the important elements for the formation of hemoglobin. Hemoglobin in red blood cells serves to bind and deliver oxygen to all body tissues. (Ministry of Health RI, 2020).

Certain foods and drinks can actually inhibit the absorption of iron in the body (Gibore et al., 2021). One of these drinks is tea. The tea leaves are usually picked from the *Camellia sinesis L. Kuntze* plant (Winarno and Wisnuwati, 2020). Tea contains polyphenols which can actually inhibit iron absorption (Partic and Indscript Creative Team, 2014). The results of research on Unguja Island, Tanzania in

March-June 2018 showed that one of the causes of anemia in pregnant women was dietary habits such as consuming tea at mealtimes (Gibore et al., 2021).

Various studies have proven that pregnant women who have the habit of drinking tea during or after eating can cause anemia. However, in recent years there has been no systematic review and meta-analysis of the relationship between tea drinking habits and the incidence of anemia in pregnant women. On this basis, researchers are interested in conducting a systematic review and meta-analysis of the relationship between tea drinking habits and the incidence of anemia in pregnant women.

SUBJECTS AND METHOD

1. Study Design
This study was conducted using a systematic review and meta-analysis. Article searches were conducted using electronic databases such as Google Scholar and PubMed. The articles used are articles published from 2013-2022. The keywords used to retrieve the article are: [("drinking tea" OR "tea consumption") AND ("anemia" AND "pregnancy") OR ("pregnant women")]. The article search results are listed in the PRISMA diagram and analyzed using the Review Manager 5.3 application.

2. Inclusion Criteria
Inclusion criteria are full paper articles with observational studies (cross-sectional), multivariate analysis with Adjusted Odd Ratios (aOR) to measure the estimated effect, research subjects are pregnant women, intervention is drinking tea, comparison is not drinking tea, research outcomes is the incidence of anemia.

3. Exclusion Criteria
Main articles published from the meta-analysis, articles published in languages

other than English, and articles prior to 2013.

4. Operational Definition of Variables

In formulating research problems PICO is used. The population is pregnant women. The intervention is drinking tea and the comparison is not drinking tea, the final result is the incidence of anemia.

Drinking tea is the consumption of drinks from tea leaves (Camellia sinesis).

The incidence of anemia is hemoglobin levels below the normal limit in pregnant women with Hb content <11 g/dL in the blood.

5. Study Instruments

Quality assessment in this study uses the Checklist for Critical Apparaisal of a Cross-Sectional Study (Survey) sourced from the Center for Evidence Based Management.

6. Data Analysis

Articles were collected using PRISMA diagrams and analyzed using the Review Manager 5.3 application by calculating effect sizes and heterogeneity to determine the combined research model and form the final results of the meta-analysis.

RESULTS

The article search process was carried out through several journal databases including Google Scholar and PubMed. The review process for related articles can be seen in the PRISMA flow diagram in figure 1. Research from a primary study related to the relationship between tea drinking and anemia in pregnant women consists of 7 articles from the initial process yielding 1,054 articles, after the deletion process of published articles with 287 of which meet the requirements for further full-text review. A total of 7 articles that met the quality assessment were included in the quantitative synthesis using a meta-analysis.

Research from a primary study related to the relationship between tea drinking and anemia in pregnant women consisted of 7 articles with 5 studies from the African continent (Ethiopia and Somalia) and 2 studies from Asia (Saudi Arabia and Nepal). Table 1, the researchers conducted an assessment of the quality of the study. table 2 shows that 7 articles from a Cross-sectional study provide evidence of the association between tea drinking and anemia in pregnant women.
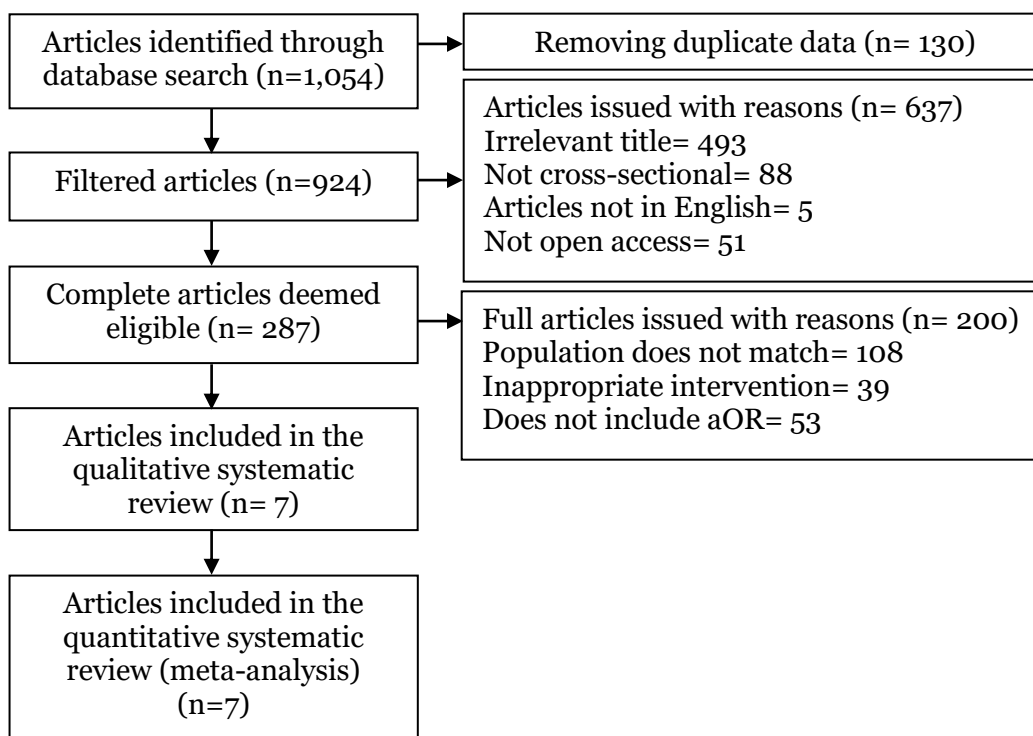
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┌─────────────────────────┐      ┌─────────────────────────────────┐
│ Articles identified     │─────▶│ Removing duplicate data (n= 130) │
│ through database search │      └─────────────────────────────────┘
│ (n=1,054)               │
└─────────────────────────┘      ┌─────────────────────────────────┐
            │                    │ Articles issued with reasons     │
            ▼                    │ (n= 637)                         │
┌─────────────────────────┐      │ Irrelevant title= 493            │
│ Filtered articles       │─────▶│ Not cross-sectional= 88          │
│ (n=924)                 │      │ Articles not in English= 5       │
└─────────────────────────┘      │ Not open access= 51              │
            │                    └─────────────────────────────────┘
            ▼                    ┌─────────────────────────────────┐
┌─────────────────────────┐      │ Full articles issued with        │
│ Complete articles       │─────▶│ reasons (n= 200)                 │
│ deemed eligible (n= 287)│      │ Population does not match= 108   │
└─────────────────────────┘      │ Inappropriate intervention= 39   │
            │                    │ Does not include aOR= 53         │
            ▼                    └─────────────────────────────────┘
┌─────────────────────────┐
│ Articles included in the│
│ qualitative systematic  │
│ review (n= 7)           │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│ Articles included in the│
│ quantitative systematic │
│ review (meta-analysis)  │
│ (n=7)                   │
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Figure 1. PRISMA Flowchart

Figure 2. Map of study area

Table 1. Assessment of study quality

No	Checklist of questions	Publication (Author and Year)						
		Ahmed et al. (2021)	Alemayehu et al. (2016)	Alreshidi and Haridi (2021)	Eteffa et al. (2022)	Feleke and Feleke (2018)	Getaneh et al. (2018)	Sumitra et al. (2017)
1.	Does the research address a clearly focused problem?	2	2	2	2	2	2	2
2.	Is the research design (cross sectional) appropriate to answer the research questions?	2	2	2	2	2	2	2
3.	Is the research subject selection method clearly explained?	2	2	2	2	2	2	2
4.	Was sampling done to minimize bias?	2	2	2	2	2	0	2
5.	Is a representative sample of subjects related to the population to which the findings will be referred?	2	2	2	2	2	2	2
6.	Was the sample size taken on the basis of pre-study statistical power considerations?	2	2	2	2	2	2	2
7.	Was a satisfactory response rate achieved?	2	2	2	2	2	2	2
8.	Is the measurement (questionnaire) valid and reliable?	2	2	2	2	2	2	2
9.	Was statistical significance assessed?	2	2	2	2	2	2	2
10.	Was a Confidence Interval (CI) given for the main outcome?	2	2	2	2	2	2	2
11.	Could there be a confounding that hasn't been reported yet?	2	2	2	2	2	2	2
12.	Can the results be applied to your organization?	2	2	2	2	2	2	2
	Total	**24**	**24**	**24**	**24**	**24**	**22**	**24**

Note: 2: Yes; 1: Can't tell; 0: No

Table 2. Description of the main studies included in the primary study of the meta-analysis

| Author (Year)	Country	Study Design	Sample	Population	Intervention	Comparison	Outcome	aOR (95%CI)
Ahmed et al. (2021)	Somalia	Cross-sectional	383	Pregnant women aged 14-45 years living in refugee settlements	Drink tea while eating	Do not consume tea with meals	Anemia	3.43 (2.00 to 5.87)
Alemayehu et al. (2016)	Ethiopia	Cross-sectional	360	Pregnant women who receive	Drink tea after eating	Don't drink tea after eating	Anemia	3.01 (1.74to 5.22)
Alreshidi and Haridi (2021)	Arab Saudi	Cross-sectional	390	blood transfusion.	Drink tea after eating	Don't drink tea after eating	Anemia	1.91 (1.21 to 3.03)
Eteffa et al. (2022)	Ethiopia	Cross-sectional	420	Pregnant women who come to ANC	Drink tea once or less per day	Not drinking tea once or less per day	Anemia	1.62 (0.79 to 3.32)
Feleke and Feleke (2018)	Ethiopia	Cross-sectional	550	Pregnant women who come to ANC	Drinking tea	Don't drink tea	Anemia	2.88 (1.54 to 5.38)
Getaneh et al. (2018)	Ethiopia	Cross-sectional	480	Pregnant women in Kota Bahir Dar	Drink tea once or less per day	Not at all	Anemia	0.50 (0.30 to 1.10)
Sumitra et al. (2017)	Nepal	Cross-sectional	280	Pregnant women attending ANC in Kota Bahir Dar	Drinking tea	Don't drink tea	Anemia	2.82 (0.57 to 13.91)
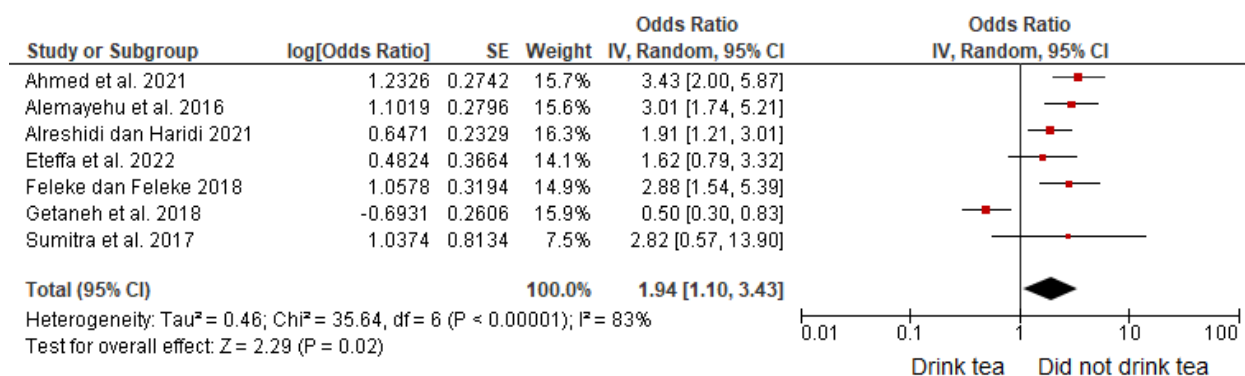
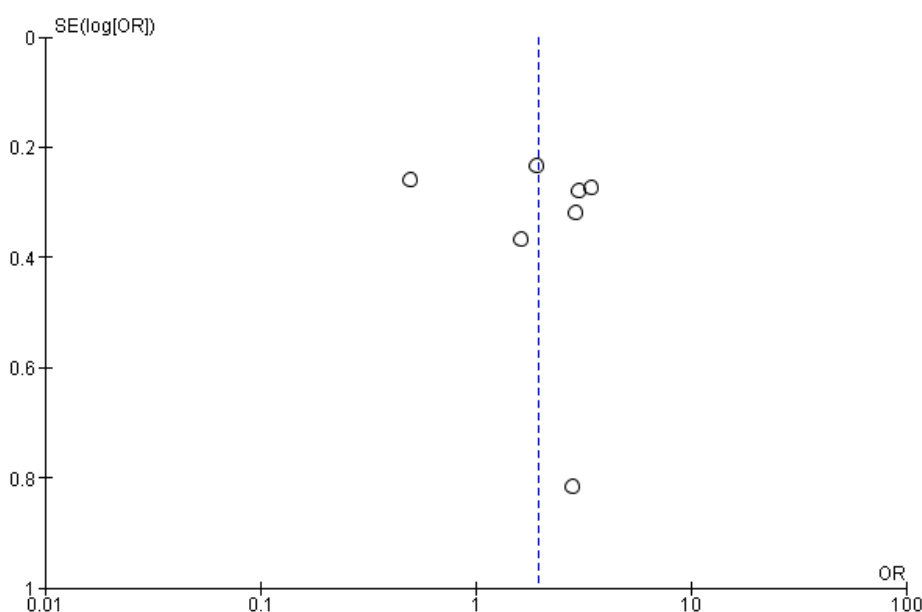**Figure 2. Forest plot of the risk of anemia in pregnant women who consume tea**

Figure 3. Funnel plot of the risk of anemia in pregnant women who consume tea

The forest plot in Figure 2 shows that there is an effect of tea drinking on the risk of anemia in pregnant women, and the effect is statistically significant. The risk of anemia in pregnant women who drank tea was 1.94 times that of pregnant women who did not drink tea (aOR=1.94; 95% CI=1.10 to 3.43; p= 0.020). The forest plot in Figure 2 also shows high heterogeneity between the effect estimates from all studies in this meta-analysis (I2=83%; p<0.001). Thus, the calculation of the average effect estimate from all studies was carried out using a random effects model approach.

A funnel plot is a plot that depicts the approximate size of the effect of each study on its estimated accuracy, which is usually the standard error. In Figure 3 the funnel plot shows the distribution of effects of all the studies in this meta-analysis more or less balanced to the right and left of the mean vertical line of the estimate. Thus, this funnel plot does not show any publication bias.

DISCUSSION

Pregnant women who are anemic have an unfavorable impact on their bodies, namely

the growth and development of the fetus in the womb is not optimal and has the potential to cause pregnancy and childbirth complications, and even maternal and child mortality (Kemenkes RI, 2020). Tea contains polyphenols which can actually inhibit iron absorption (Partic and Indscript Creative Team, 2014). This meta-analysis study investigated the relationship between tea drinking habits and the incidence of anemia in pregnant women. The independent variable is drinking tea and the dependent variable is the incidence of anemia. The intervention is drinking tea. This study is important because drinking tea in pregnant women will affect the incidence of anemia.

This study explains that the risk of anemia in pregnant women who drink tea is 1.94 times that of pregnant women who do not drink tea (aOR = 1.94; 95% CI = 1.10 to 3.43; p= 0.020). This meta-analysis provides evidence that pregnant women who drink tea are more at risk of developing anemia. In this study, there was no publication bias.

The results of this study are in line with research conducted by Feleke and Feleke (2018) with a sample of pregnant women in Bahir Dar, Ethiopia from November 2014 to May 2015. The results showed that anemia in pregnant women was positively related to tea consumption (aOR 3.63; CI 95%=2.56–5.14). This is due to the presence of chemicals in tea that can inhibit the absorption of iron.

Anemia is found in pregnant women who consume tea. Hemoglobin levels in pregnant women who did not drink tea were 12.08 mg/dl ± 1.32 and pregnant women who drank tea were 8.57±2.57 mg/dl (p=0.001). Linear regression analysis of hemoglobin and tea showed a significant relationship between tea consumption and the incidence of anemia (p<0.050).

A glass of tea (about 200 ml) can reduce iron absorption by about 75-80%. These variations are influenced by differences in the amount, brand, and brewing time of tea. Tea that meets iron will cause a coordination reaction between metal ions and organic molecules that have at least a pair of electrons at each end, so that the organic molecule is like flanking the metal ion. This bond can cause the solution to decrease in concentration. This bond occurs due to the presence of polyphenols in tea, one of which is tannins (Hallberg and Hulthén, 2000).

In contrast to Sumitra's research (2017), drinking tea does not have a significant relationship with the incidence of anemia in pregnant women. Iron supplementation is a major determinant of anemia in pregnancy. These findings emphasize the importance of increasing awareness of regular iron intake during pregnancy. (Sumitra and Kumari, 2017). The risk of anemia is lower in women who regularly consume iron (Feleke and Feleke, 2018).

A study in Hyderabad, Pakistan showed that pregnant women who consumed tea had a significant increase in hemoglobin levels in those who consumed more red meat. (Baig-Ansari et al., 2014). In another study, pregnant women who consumed tea without eating meat at least once per week were twice as likely to develop anemia as those who ate meat at least once per week (aOR= 2.07; 95% CI=1.03 to 4.15). This is because meat is a good source of heme iron (Weldekidan et al., 2018).

The limitations of this study are that there is a language bias because it only uses English articles, a publication bias shown in

the funnel plot results, and a search bias because it only uses two databases.

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