

Association of Parasitic Infection and Anemia in Pregnant Women in Ethiopia- A Systemic Review and Meta-analysis

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ABSTRACT

Objective: The aim of this systemic review and meta-analysis was to examine the relationship between intestinal parasitic infection and anemia among pregnant women in Ethiopia. We include six studies in different regions of Ethiopia. We have done this study focusing on intestinal parasitic infection.

Materials and Methods: The databases searched were PUBMED and Advanced Google Scholar. On reference manager software reporting intestinal parasitic infection and anemia among pregnant women. Three researchers have carried out the data extraction and assessed independently the articles for inclusion in the review using the risk-of-bias tool guided by the PRISMA checklist. The combined adjusted Odds Ratios (OR) and 95% confidence intervals were calculated using a random-effect model.

Results: Six observational studies involving 2838 participants, 557 pregnant women who have anemia were included. The combined effect size (OR) for anemia comparing pregnant women who have intestinal parasitic infection *versus* pregnant women who did not have intestinal parasitic infection was 3.74 (ORMH=3.74, 95% CI 2.58-5.43) Heterogeneity: Tau²=0.13; Chi²=13.11, df=5 (p=0.02); I²=62% Test for overall effect: Z=6.94 (p< 0.00001). No publication bias was observed (Egger's test: p= 0.074, Begg's test: p=0.091). 23.99% (681) of pregnant women have intestinal parasitic infections during the current pregnancy. In all studies, the proportion of anemia among pregnant women who have intestinal parasitic infections during the current pregnancy was 227 (33.33%).

Conclusions: The likelihood of anemia among pregnant women is approximately four times higher among pregnant women who had intestinal parasitic infections than those who did not have the infection in Ethiopia.

Keywords: Determinant of anemia; Intestinal parasitic infection; Meta-analysis; Systematic reviews; Ethiopia

INTRODUCTION

Pregnant women with a Hemoglobin level less than 11 g/dl are considered to be anemic [1]. In the world, 56 million pregnant women are anemic [2]. In Africa, the magnitude of anemia among pregnant women was 57.1% [3]. The prevalence of anemia among pregnant women in Ethiopia is 63% and in east Africa countries 55% in Kenya, 58% in Sudan and Eritrea 55.3% [4]. Different factors might lead to anemia among pregnant women. Geohelminth infections during pregnancy were associated with maternal anemia. Hookworm infection causes anemia among pregnant women and it also aggravates anemia in pregnant women [5].

Infections by helminths lead to malnutrition, iron deficiency anemia, and increased vulnerability to other infections in

infected pregnant women [6]. Other recent studies in Ethiopia have reported a prevalence of anemia ranging from 16.6% in a facility-based study in Gondar, northwest Ethiopia to 56.8% in Gode town, Eastern Ethiopia [6,7]. Prior studies in Ethiopia have reported significant associations between anemia in pregnancy and parasitic infections (e.g. schistosomiasis, hookworm infection), prior use of contraceptives, use of iron supplementation, birth spacing/ intervals, parity and gravidity, educational attainment, age, body weight, trimester of pregnancy and wealth status [6-18].

Despite there are many types of research done on anemia among pregnant women in Ethiopia, but data on intestinal parasitic infection and anemia among pregnant women in Ethiopia is not adequate. This systematic review and meta-analysis were conducted to assess the relationship between intestinal parasitic infection and

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Received: August 25, 2021; **Accepted:** September 22, 2021; **Published:** September 30, 2021

Citation: Tegegne KT, Tegegne ET, Tessema MK, Assefa (2021) Association of Parasitic Infection and Anemia in Pregnant Women in Ethiopia- A systemic review and Meta-analysis. J Trop Dis 9:301.

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anemia among pregnant women in Ethiopia.

METHODS

Search approach and appraisal of studies

Studies were searched using primary key terms of “determinant of anemia”, “anemia”, “intestinal parasitic infection”, “intestinal parasitic infection and anemia”, “Ethiopia” and to generate additional keywords for the search we were used the following search strategies, intestinal parasitic infection+anemia+pregnant women+Ethiopia through Electronic databases on reference manager software.

The databases searched were PUBMED and Advanced Google Scholar. References of studies that meet eligibility criteria were used to identify similar articles.

Inclusion criteria

- All Studies that were assessed the relationship between intestinal parasitic infection and anemia.
- The outcome of interest was anemia
- The study reported the percentage of anemia according to intestinal parasitic infection
- Meet quality assessment

Exclusion criteria

- Studies that were published in languages other than English
- Included participants with anemia not dichotomized as anemia and no anemia
- Included participants with intestinal parasitic infection not dichotomized as yes and no
- Studies conducted not in Ethiopia were also excluded to avoid the combination of studies that were not comparable

Data Extraction

Three researchers have carried out the data extraction. The extracted information was the name of the author, study area, the number and percentage of anemia, the number and percentage of intestinal parasitic infections.

Risk of bias and quality assessment

To assess external and internal validity, a risk-of-bias tool was used. The tool has seven items:

- » Random sequence generation (selection bias)
- » Allocation concealment (selection bias)
- » Blinding of participants (performance bias)
- » Blinding of outcome assessment (detection bias)
- » Incomplete outcome data (attrition bias)
- » Selective reporting (reporting bias)
- » Other bias

All of these items are rated based on the author’s subjective judgment given responses to the preceding seven items rated as low, moderate, or high risk. Three reviewers assessed independently the articles for inclusion in the review using a risk-of-bias tool and guided by the PRISMA checklist [19]. A discrepancy that would face by reviewers on the selection of studies and data extraction were resolved by

discussion. Additionally, all potential confounding variables were controlled by multivariable analysis in all included studies.

Measures

Outcome variable pregnant women with a Hemoglobin level less than 11 g/dl are considered to be anemic [1].

Statistical analysis

The necessary information was extracted from each original study by using a format prepared in a Microsoft Excel spreadsheet and transferred to Meta-essential and RevMan software for further analysis.

The pooled effect size of anemia was estimated from the reported proportion of eligible studies using RevMan V.5.3 software. Forest plots were generated displaying MH odd ratio with the corresponding 95% CIs for each study. As the test statistic showed significant heterogeneity among studies Heterogeneity: $Tau^2=0.13$; $Chi^2=13.11$, $df=5$ ($p=0.02$); $I^2=62%$) the Random-effects model was used to estimate the DerSimonian and Laird's pooled effect.

Assessment of publication bias

Funnel plot asymmetry and Egger’s test was used to check the publication bias.

RESULT

Selected studies

Figure 1 shows the selection process of studies 120 of records identified through database searching 40 of records after duplicates removed 33 of records screened and 13 of records excluded. 20 of full-text articles assessed for eligibility and 14 of full-text articles

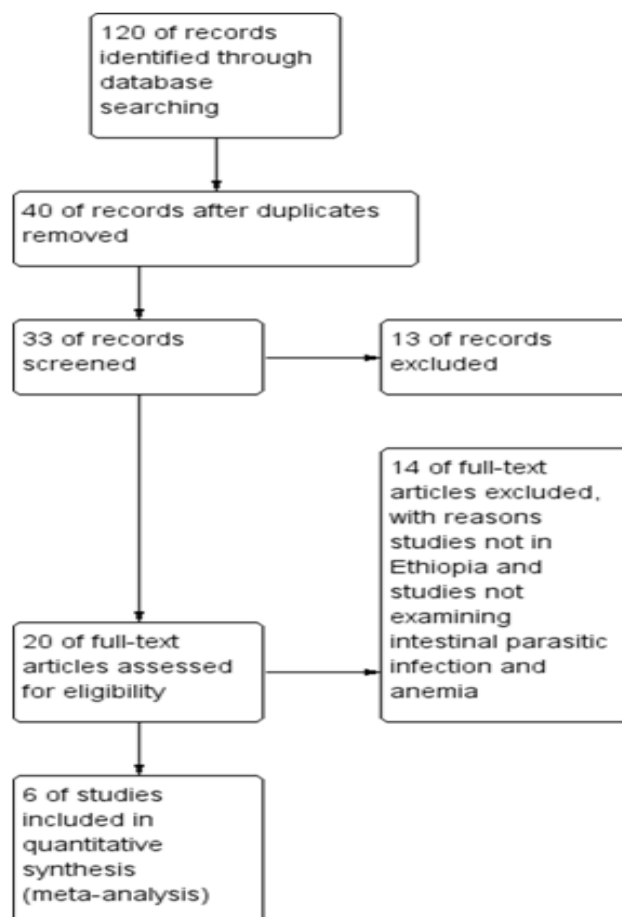


Figure 1: Selection process of studies.

excluded, with reasons, studies not in Ethiopia and studies not examining intestinal parasitic infection and anemia and finally 6 of studies included in quantitative synthesis (meta-analysis).

Characteristics of included studies

Six observational studies involving 2838 participants, 557 pregnant women who have anemia were included (Table 1).

In all studies, the proportion of anemia among pregnant women who have the intestinal parasitic infection during the current pregnancy was 227 (33.33%).

Pooled effect size

The odds of anemia among pregnant women who had intestinal parasitic infection is 3.74 times higher than those pregnant women who did not have intestinal parasitic infection (ORMH =3.74, 95% CI 2.58-5.43). Heterogeneity: Tau²=0.13; Chi²=13.11, df=5 (p=0.02); I²=62%. Test for overall effect: Z=6.94 (p<0.00001) (Figure 2).

Assessment of publication bias analysis

No publication bias was observed (Egger’s test: p=0.074, Begg’s test: p=0.091) (Figure 3).

The below 'Abbe plot showed that all studies effect size is above the zero effect size (Figure 4).

The below Galbraith plot showed that 95% of the studies effect size lie between the two color lines and this indicates there is no outlier of effect size (Figure 5).

DISCUSSION

In this systematic review and meta-analysis, pregnant women who were infected with intestinal parasites were 3.74 times more likely to be anemic than those who were not infected by an intestinal parasite and this is consistent with previous studies [6,20-25]. The worm in the intestine may cause intestinal necrosis and blood loss as a result of the attachment to the intestinal mucosa and chronic infections lead to iron deficiency and anemia resulting from the excessive loss of iron [26].

Table 1: Shows description of original studies included (n=6).

S.no	Articles	Anemia	
		Yes	No
1	Lebso M, Anato A, Loha E (2017) Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia: A community-based cross-sectional study. PLoS ONE 12(12): e0188783. https://doi.org/10.1371/journal.pone.0188783	Yes	53
		No	279
2	Argaw B, Argaw-Denboba A, Taye B, Worku A, Worku A (2015) Major Risk Factors Predicting Anemia Development during Pregnancy: Unmatched-Case Control Study. J Community Med Health Educ 5: 353. doi:10.4172/2161-0711.1000353	Yes	35
		No	397
3	Hailu et al. Determinant factors of anemia among pregnant women attending antenatal care clinic in Northwest Ethiopia Tropical Diseases, Travel Medicine and Vaccines (2019) 5:13 https://doi.org/10.1186/s40794-019-0088-6	Yes	56
		No	442
4	Fekede Weldekidan et al Determinants of Anemia among Pregnant Women Attending Antenatal Clinic in Public Health Facilities at Durame Town: Unmatched Case-Control Study Anemia Volume 2018, Article ID 8938307, 8 pages https://doi.org/10.1155/2018/8938307	Yes	49
		No	179
5	Getahun et al. Burden and associated factors of anemia among pregnant women attending antenatal care in southern Ethiopia: cross-sectional study BMC Res Notes (2017) 10:276 DOI 10.1186/s13104-017-2605-x	Yes	21
		No	150
6	Kebede et al. The magnitude of anemia and associated factors among pregnant women attending public institutions of Shire Town, Shire, Tigray, Northern Ethiopia, 2018 BMC Res Notes (2018) 11:595 https://doi.org/10.1186/s13104-018-3706-x	Yes	13
		No	380

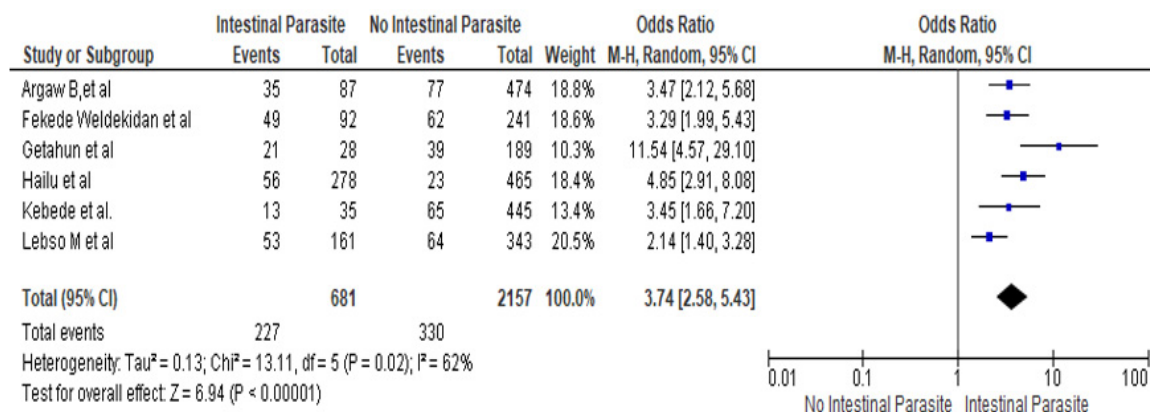


Figure 2: Forest plot for the association between intestinal parasite infection and anemia among pregnant women in Ethiopia.

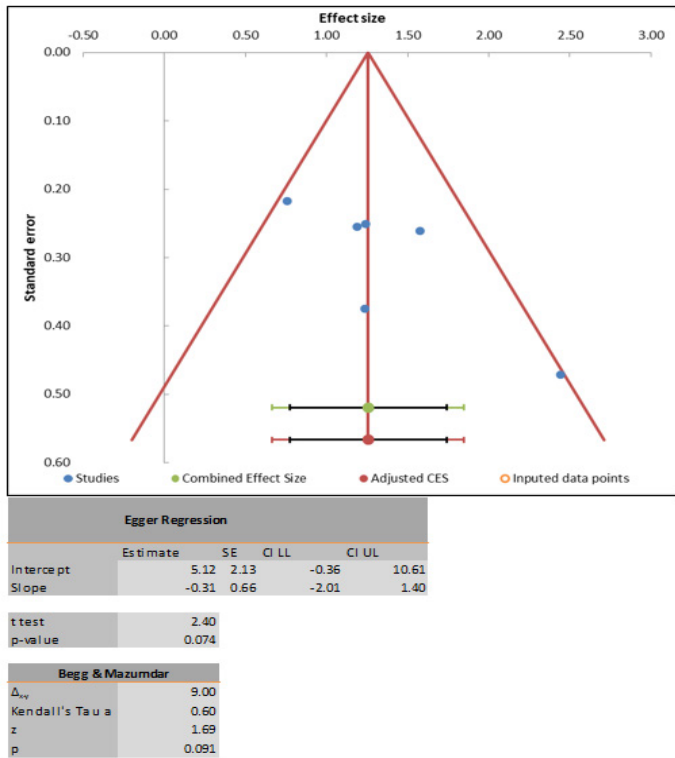
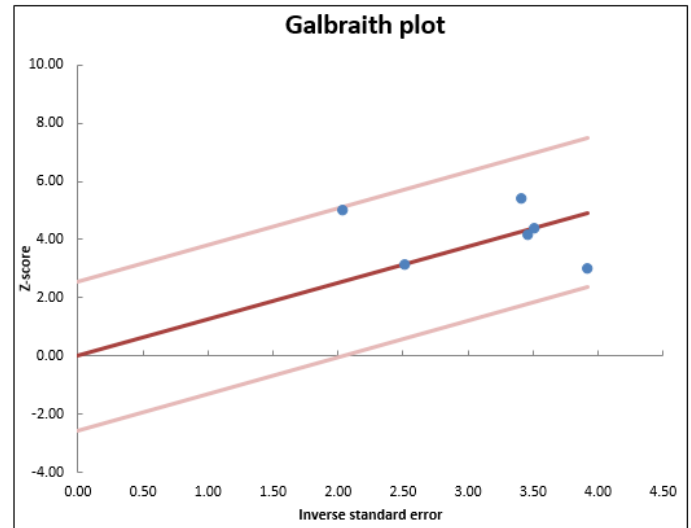


Figure 3: Funnel plot for the association between intestinal parasite infection and anemia among pregnant women in Ethiopia.



Regression estimate				
	Estimate	SE	CI LL	CI UL
Intercept	0.00			
Slope	1.26	0.19	0.77	1.74

Figure 5: Galbraith plot for the association between intestinal parasite infection and anemia among pregnant women in Ethiopia.

environmental sanitation status may also aggravate the chance of intestinal parasite infection.

Parasitic diseases were known to play a major contributing factor to anemia in pregnancy. For example, blood loss caused by hookworm puts mothers at high risk of iron deficiency anemia [29]. Our finding is similar to many previous studies conducted in Ethiopia and other developing countries that have shown the strong association of intestinal parasitic infection with anemia in pregnant women [24,29-34]. The parasitic infection has a devastating effect on the level of Hgb, causes anemia since they affect iron absorption by the intestine, and consumes the red blood cells [35].

There was a strong significant association between intestinal parasitic infection and anemia in pregnant women. In previous studies [36], in Southern Ethiopia [20], Ghana [35], Nigeria [37], and Venezuela [38], Durame Town Ethiopia [39], in Yirgalem and Hawassa cities, Dessie town and Canada [28,34,40], Shire Town, Tigray, Northern Ethiopia [41], in Shalla Woreda of Oromia region In Ethiopia [16].

This is expected, as intestinal parasites, apart from their competition for nutrients, are known to cause blood loss, loss of appetite-reduced motility of food through the intestine and damage to the wall of the intestine leading to mal-absorption of nutrients.

CONCLUSION

The likelihood of anemia among pregnant women is approximately four times higher among pregnant women who had intestinal parasitic infection than who did not have the infection.

DATA AVAILABILITY

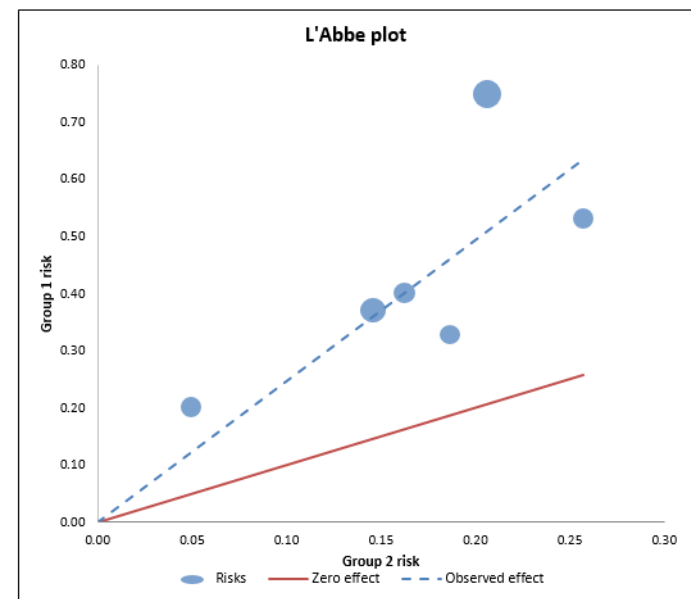
All data are included in the paper.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHORS' CONTRIBUTIONS

Kaleab Tesfaye Tegege, Eleni Tesfaye Tegege, and Mekibib



Combined effect size	
Fixed effect model	
Risk Ratio	2.47

Figure 4: 'Abbe plot for the association between intestinal parasite infection and anemia among pregnant women in Ethiopia.

Therefore, effective intervention packages need to reduce anemia among pregnant women through iron supplementation, anthelmintic treatment, and dietary diversification in the study area [27]. Our finding is similar to other previous studies in Ethiopia [28]. This possibly happen because most anemic pregnant women who are living in Ethiopia were farmers, barefoot walking is common among Ethiopian farmers, and the chance to be exposed to the soil-transmitted parasite is very high. Besides this, the low

Kassa Tessema were responsible for conceptualization, project administration, software, supervision, and development of the original drafting of the manuscript. Kaleab Tesfaye Tegegne, Eleni Tesfaye Tegegne, and Mekibib Kassa Tessema and Abiyu Ayalew Assefa have participated in quality assessment of articles, methodology, validation, and screening of research papers. All authors contributed with data analysis, critically revised the paper, and agreed to be accountable for their contribution.

ACKNOWLEDGMENTS

We would like to thank all the primary authors of the included articles.

COMPETING OF INTEREST

The authors have declared that there is no competing interest.

FUNDING

No funding was received for this work.

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