

Under nutrition and associated factors among lactating mothers in Ethiopia: A systematic review and meta-analysis

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Abstract

Abstract

Background: Under nutrition is a global problem and in increasing trend in recent years. The burden is high in low and middle-income countries; especially in Africa. Lactating women are among the most vulnerable groups for undernutrition; especially in sub-Saharan Africa. However, the prevalence of undernutrition among this group is inconsistent and inconclusive in Ethiopia, and also the national nutritional plan of 2015 is not yet achieved. Furthermore, to achieve the 2030 Sustainable developmental plan, conducting this type of summarized reviews are helpful. Therefore, we aimed to assess the pooled prevalence of undernutrition and its associated factors among lactating mothers in Ethiopia.

Methods: To write this review and meta-analysis we followed the preferred reporting items for systematic reviews and meta-analysis guidelines. We used PubMed, Hinari, Cochrane Library, science direct databases, Google, and Google scholar for searching. STATA version 14 software and a standardized format were used for analysis and data extraction respectively. Heterogeneity was checked using I^2 . A random-effect meta-analysis model was used to determine the pooled prevalence of undernutrition. Begg's and Egger's tests were conducted to detect publication bias. Subgroup analysis was also conducted and association was expressed by a pooled odds ratio with 95% CI.

Result: A total of 16 studies were included with a total of 7830 Ethiopian lactating women. The pooled prevalence of undernutrition among lactating mothers was found to be 23.86% (95% CI: 19.01, 28.72). The result of heterogeneity test was $I^2 = 96.7\%$ and $p < 0.001$). The Begg's and Eger's test findings after we removed two influential primary articles were $P: 0.443$ and $P: 0.306$ respectively. Educational status (no formal education) (Pooled OR: 2.30 (95% CI: 1.34, 3.96)) was significantly associated with undernutrition.

Conclusion: The pooled prevalence of undernutrition was high. Maternal educational status was significantly associated with undernutrition. Therefore, the federal ministry of health and the concerned stakeholders should give attention to these most vulnerable groups, refine their strategies to address this issue, and strengthen the implementation of the previously designed strategies.

Background

Nutritional is a vital indicator of the complete health of a population and pillar of development [1]. Undernutrition is more prevalent among children and women; especially in lactating and pregnant mothers. Undernutrition is responsible for 3.5 million maternal and children deaths, 35% of children disease burden, 20% of maternal mortality, and 11% of daily-adjusted life-years (DALYs) [2]. Maternal undernutrition is well-defined as having a body mass index (BMI) of $< 18.5 \text{ kg/m}^2$ [3].

During lactation, there is a high need of energy and nutrients, unless achieved results in poor nutritional status, poor breast milk quality [7, 8] and also has a long term impact on the health of the child and as well as to the community [4]. It also increases the risk of under-five mortality and morbidity [5–7]

Globally, maternal undernutrition is a serious problem but more prevalent in sub-Saharan Africa, south-central, and southeastern Asia countries [8]. In 2018, 10.8% of the world population were undernourished, 19.9% in Africa [9]. In the globe, the prevalence of underweight among women ranges between 10 to 19% [2]. In Sub-Saharan Africa countries 10–20% of women are undernourished [10]. Even though all women have a risk for under nutrition, the burden is more common in lactating mothers due to more energy and nutrient requirement than pre-pregnancy and pregnancy periods [11]. Lactating women from low-income countries especially in South East Asia and sub-Saharan African are more vulnerable group to undernutrition [12, 13]. In Ethiopia, the prevalence of undernutrition among general women is 20.6% [14] and the prevalence of undernutrition among lactating mothers ranges from 5.6 to 54.7% [15, 16].

Low level of educational status, Food insecurity, low dietary diversity score, low family income, and family size were some of the determinants for undernutrition among lactating women [3, 17–19]. One of the target strategic plans under the National Nutrition Program (NNP) by the year 2015 of Ethiopia was dropping the prevalence of undernutrition from 27 to 19 %, but not yet achieved.

Even though several studies were conducted in Ethiopia, all of the studies were single studies and there was a wide range of discrepancy in under-nutrition prevalence among lactating mothers in Ethiopia that ranges from 5.6 to 54.7% [15, 16]. Consequently, providing summarized evidence is important for policy maker's to revise their strategies and to strengthen the implementation of the designed interventions and to achieve the global sustainable development plan goal 2.2 and 3.1 [20]. Therefore, this systematic review and meta-analysis study was aimed to assess the pooled prevalence of under-nutrition and its associated factors among lactating mothers in Ethiopia.

Methods

Searching Strategy

Initially, databases were searched to check for the presence of similar systematic review to avoid duplication using website <https://www2.le.ac.uk/library/find/databases/p/Prospero>. Searching of primary articles was conducted from PubMed, Hinari, Science Direct, and Cochrane library databases. Furthermore, grey literature was retrieved from Google and Google scholar. Furthermore, the reference lists of published articles were searched to recognize other relevant articles that did not shown in databases. During the search process, to decrease the number of unrelated studies, the search was restricted to only 'human studies', 'women', and 'English language' in the advanced search. The search for primary articles was started on June 26, 2020, and end on August 3, 2020. For searching purposes, we used "Undernutrition OR Underweight AND lactating mothers AND Ethiopia" for objective one and "Determinants OR factors OR predictors AND lactating mothers AND Ethiopia for the second objective as

keywords. Both published and unpublished articles that fulfill the eligibility criteria were included in this systematic review and meta-analysis. During writing this review and meta-analysis we used the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines [21]. Articles were downloaded to Endnote version X7 to maintain and manage citations, facilitate the review process, and to check duplication of articles.

Eligibility criteria

Eligibility assessment was executed independently by BG and JN in an unblinded identical manner based on the stated inclusion and exclusion criteria. We solved disagreements by consensus and discussion with the two remaining authors.

Inclusion criteria

All observational studies (cross-sectional, case-control, and cohort studies) conducted in Ethiopia among lactating mothers and published in English were included. Moreover, articles reporting the prevalence of undernutrition ($\text{BMI} < 18.5 \text{kg/m}^2$) and associated factors were included. Both published and unpublished full articles were considered. Both institutional and community-based studies were encompassed.

Exclusion criteria

Studies conducted among both lactating and pregnant mothers were excluded.

Outcome measures

This systematic review and meta-analysis have two objectives. The first was to estimate the pooled prevalence of undernutrition among lactating mothers in Ethiopia and it was calculated by dividing the number of lactating mothers with this problem to the total number of lactating mothers included in the study and multiplied by 100. All articles included in this review and meta-analysis used BMI score ($< 18.5 \text{kg/m}^2$) to assess undernutrition among lactating mothers. The second objective was to determine the pooled effects of factors on undernutrition among lactating mothers in Ethiopia. In this systematic review and meta-analysis variables identified as a factor in two and above studies (articles) were considered to include. To express the pooled effects we used odds ratio (OR) that was calculated from the 2x2 table.

Quality assessment and data extraction

Newcastle Ottawa Scale adapted for cross-sectional studies was used to assess the quality of the included studies [22]. BG and JN have appraised the studies independently using the above tool. The tool has the following parameters sampling strategy, inclusion/exclusion criteria, sample size, cut-offs, and reference for the assessment of lactating women undernutrition status, criteria to identify undernutrition, and covariates included in statistical models. The tool comprised 10 criteria for rating different quality elements. After quality assessment studies with high quality (scored 6 and above out of 10) were included for analysis. During the quality assessment, any divergences were solved through discussion, by taking the average result of the two appraisers and by giving the decision for the remaining two authors.

All the necessary data were extracted using a standardized Microsoft Excel data extraction format by two authors (BG and JN) separately. We used two data extraction formats, one for each objective. For the prevalence of undernutrition the data extraction format comprised author name, publication year, region the study conducted, study design, sample size, response rate, outcome measurement tool, study quality score, and prevalence of undernutrition. We also used two by two tables to extract data for objective two (factors for Undernutrition). Any incongruities during the data extraction period between the two authors (BG and JN) were resolved through discussion, twofold checking the varying data together, and third author invitation.

Publication bias and heterogeneity

Publication bias was assessed by both methods, funnel plots that are the subjective method used to test for asymmetry [23], and Egger's statistical test [24]. To declare the statistical significance of publication bias we used a p -value < 0.05 . After a comprehensive examination of the included studies, heterogeneity of the studies was assessed by I^2 test statistics. I^2 statistics described the total variation across studies and declared as low, moderate, and high heterogeneity if it is < 50 , $50-75\%$, and $> 75\%$ respectively [25].

Statistical method and analysis

We extracted important data from each study using a Microsoft excel spreadsheets and the data were exported to STATA software version 14 for analysis. The standard error of prevalence for each original article was calculated using the binomial distribution formula. The effect size of the meta-analysis was the prevalence of Undernutrition and OR of the associated factors. We used a random-effect model for analysis [26]. To check the source of heterogeneity we conducted a leave-one study-out sensitivity analysis and subgroup analysis [27–29]. The effect of the selected associated factors on the outcome variable was examined using separate groups of meta-analysis. To describe the features of the included articles and to display the finding of this review and meta-analysis we used texts, tables, forest plots, and OR and 95% confidence intervals (CI).

Results

Study search and selection

After fixing the searching with 'full-text articles', 'women', 'English language' we found a total of 260 primary articles from PubMed (11), Hinari (53), Cochrane library (13), science direct (13) databases, and Google scholar (150) and Google (20). Of these, 94 articles and 148 articles were excluded due to duplication and title and abstract screening respectively. A total of 18 articles were selected for full article reading and 2 records were additionally removed by the studies were conducted in both lactating and pregnant mothers together [30, 31]. Lastly, 16 articles were selected for the final review and meta-analysis [13, 15, 16, 32–43] [Figure 1].

Characteristics of the studies and systematic review

Except for one study [40], all of the included articles were cross-sectional studies. The study was conducted among 7830 Ethiopian lactating women. In this review and meta-analysis, the included articles showed a sample size ranging from 216 [16] to 1140 [32]. Nine (56.2%) of the included studies used a simple random sampling technique [13, 15, 16, 32–34, 38, 41, 43]. Ten (62.5%) of the included studies were conducted in 2017 [15, 34, 36, 37, 39–44] and then after, and only one of the included studies were conducted before 2010 [32]. Regarding the region where the study conducted 6 (31.2%) were from Oromia [15, 33, 35, 38, 39, 43], three were from SNNP [34, 37, 44], three were from Tigray [13, 36, 40], two were from Amhara [41, 42] and 2 were from Addis Ababa [32], and Tigray and Oromia region [16] jointly, one in each. The highest prevalence of undernutrition among lactating women was reported from a study done in Tigray and Oromia region jointly (54.7%) [16] and the least was from the Oromia region (5.6%) [15] [Table 1].

Prevalence of undernutrition among lactating women

Sixteen studies were included in this meta-analysis to estimate the pooled prevalence of undernutrition among lactating mothers. The heterogeneity of studies used to estimate the pooled prevalence of undernutrition was very high ($I^2 = 96.7\%$ and $p < 0.001$). Due to this heterogeneity, we used the random-effects model to estimate the pooled prevalence of undernutrition and it was 23.86% (95% CI: 19.01, 28.72) [Figure 2]. In this review and meta-analysis, there was publication bias that was confirmed by Egger's test ($P: 0.001$) and the Funnel plot [Figure 3]. But after we removed the highly varying two studies [15, 16], the pooled prevalence of undernutrition was 23.12 (95% CI: 19.95, 26.26) and the result of Begg's and Egger's test results was $P: 0.443$ and $P: 0.306$ respectively. A subgroup analysis was computed to compare the prevalence undernutrition by region, publication year, and design type. Thus, the estimated pooled prevalence of undernutrition was high in a study conducted in two regions jointly (Tigray and Oromia) 54.7% (95% CI: 47.85, 61.55), and the least was in SNNP 19.67 (95% CI: 13.78, 25.55). The least heterogeneity of studies was observed among studies conducted in Amhara, Ethiopia ($I^2 = 31.6\%$ and $p < 0.226$). Likewise, the subgroup analysis by publication year showed that undernutrition was high in

studies conducted on 2017 and before 28.27 (95% CI: 22.33, 34.21), and also the subgroup analysis by design showed that studies conducted at community had a high prevalence 24.26 (95% CI: 18.12, 30.41) [Table 2].

Factors associated undernutrition among lactating mothers

To assess the factors in this review and meta-analysis we included factors that were significant at least in two primary studies. Dietary diversity, food insecurity, maternal educational status, age, family income, postnatal care service, and family size were identified as a significant factor for undernutrition. However, only food insecurity and educational status were hold all the necessary data to construct 2x2 tables and reported with similar categories across studies. The remaining factors were reported with different categories and don't contain exposed and unexposed group data. Therefore, due to this reason, we assess the association of the two mentioned factors that contain pertinent data to calculate the effect and undernutrition among lactating mothers in Ethiopia.

Among the two factors included for meta-analysis, food insecurity was a factor in two studies [37, 39] and educational status was identified as a factor for undernutrition in four studies [33, 37, 43, 44]. However, in this meta-analysis, illiterate lactating women in Ethiopia had 2.3 times more risk to develop undernutrition as compared to their counterparts (OR: 2.30 (95% CI: 1.34, 3.96), and I^2 : 82.8% and P : <0.001) [Figure 4] but there was no association between food insecurity and undernutrition (OR; 3.29 (95% CI: 0.65, 16.76)) [Figure 5].

Discussion

Lactating women are more vulnerable to undernutrition because they have high food and nutrient requirements during that period [45–47]. Undernutrition during lactation results in long-term effects on later health of the child and the mother [48–50] and if it occurs in adolescents reduces their ability to learn and work at maximum efficiency, affects sexual maturation, and averting the accomplishment of normal bone and teeth strength [51]. Furthermore, undernutrition is a cyclic problem that passes from one generation to another unless controlled early and it also can impact country productivity [11].

In this review and meta-analysis, we aimed to assess the pooled prevalence of undernutrition and its associated factors among lactating women in Ethiopia. We used the Newcastle-Ottawa Scale (NOS) for observational studies to assess the quality of the included articles and only studies scored six and above out of ten were included in this review and meta-analysis. Due to the existence of heterogeneity random effect model was used for meta-analysis and the pooled prevalence of undernutrition was found to be 23.86% (95% CI: 19.01, 28.72).

The pooled prevalence of undernutrition was 23.86% (95% CI: 19.01, 28.72) and it was similar with studies finding done in seven African countries (12.6% - 31.9%), systematic review done in Africa (23.5%) [18], Iran (26.11%) [52] and rural Vietnam (23.7%) [53]. High as compared to studies done in Uganda

(8.2%) [19], India (16.9%) [54], Bangladesh (16.1%) [54], Indonesia (9%) [55], Ethiopia among general women (20.6%) [14] and the global standard acceptable malnutrition rate (10%) [56]. The reason might be lactating women are more vulnerable due to double burden to meet the requirement of her and her child nutrients and energy need, the difference in sample size for instance in Uganda 1356 women, health service quality variation, cultural and socioeconomic variation. This finding was low as compared to the WHO report of Ethiopia (26.9%) [57] this might be due to improvement in service delivery in recent years. In the subgroup analysis by publication year high prevalence was seen on studies done in 2017 and before 28.27 (22.33, 34.21) this might be due to improvement in service delivery quality in recent years.

In this meta-analysis, we assessed the association of food insecurity and maternal educational status with the undernutrition among lactating mothers. However, Ethiopia is one of the food-insecure countries and 10% of Ethiopian citizens are chronically food insecure [58], and the finding of a review and meta-analysis done in Africa revealed that food insecurity is a significant factor for undernutrition among women, in this study food insecurity hadn't any association with undernutrition (OR; 3.29 (95% CI: 0.65, 16.76)). This might be because in this study only two studies were included to check this fact.

In this review and meta-analysis, maternal educational status was identified as a significant factor for undernutrition among lactating women; illiterate lactating women had 2.3 times more risk for undernutrition as compared to literate women (Pooled OR: 2.30 (95% CI: 1.34, 3.96). This finding was similar to the food and agriculture organization (FAO) study cross countries [59], studies done in India [60], Uganda [19], and Tanzania [3]. Moreover, it was similar to a systematic review done on adolescent undernutrition [61]. This might be for the reason that illiterate women have low nutritional knowledge, low economic status, high household burden, and low right decision-making ability that leads to low use of health care facilities, accessibility of nutritious food, and low health promoting behaviour [62, 63].

Even though this study is a systematic review and meta-analysis, it has some limitations. Of which high percent of heterogeneity across studies, publication bias, a small number of factors assessed to check their association with undernutrition, and a small number of studies included to estimate the effect size of associated factors were some of the limitations observed in this review.

Conclusion

The pooled prevalence of undernutrition among lactating mothers was found to be high as compared to the national and global figures. Maternal education status was identified as a significant predictor for undernutrition. To decrease this burden, the federal ministry of health and stake holders should strengthen their follow-up on the implementation of the designed strategies for this special group since they are more vulnerable among all women. Furthermore, since in Ethiopia 40.4% of women are illiterate [64] long term plan should be designed to increase the access of education for women that was one of the goals of the global sustainable development plan and it is important to decrease the burden of undernutrition among lactating women.

Abbreviations

BMI- Body Mass Index, **CI**- Confidence interval, **NNP**- National Nutrition Program, **OR**- odd ratio, **SNNP**- South Nations and Nationalities People

Declarations

Ethics approval

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The data included in this study is available and can be accessed by contacting the corresponding author through this email address; bekahegngi@gmail.com or Bekahegng@du.edu.et.

Competing interests

All authors declare that they have no competing interests.

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Authors' contributions

BG and JN conceived the idea, participated in data extraction, analysis and draft writing. AM and MM participated in the analysis, manuscript preparation, and revision. All authors read and approved the final version of the manuscript to be considered for publication.

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References

1. Daba G, Beyene F, Fekadu H, Garoma W: Assessment of knowledge of pregnant mothers on maternal nutrition and associated factors in Guto Gida Woreda, East Wollega Zone, Ethiopia. *Journal of Nutrition & Food Sciences* 2013, 3(6):1.
2. Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, Mathers C, Rivera J, Maternal, Group CUS: Maternal and child undernutrition: global and regional exposures and health consequences. *The lancet* 2008, 371(9608):243-260.
3. Mtumwa AH, Paul E, Vuai SA: Determinants of undernutrition among women of reproductive age in Tanzania mainland. *South African Journal of Clinical Nutrition* 2016, 29(2):75-81.
4. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, Sachdev HS, Maternal, Group CUS: Maternal and child undernutrition: consequences for adult health and human capital. *The lancet* 2008, 371(9609):340-357.
5. Demissie T, Mekonen Y, Haider J: Agroecological comparison of levels and correlates of nutritional status of women. *Ethiopian Journal of Health Development* 2003, 17(3):189-196.
6. Sanusi R, Falana O: The nutritional status of mothers practicing breast feeding in Ibadan, Nigeria. *African Journal of Biomedical Research* 2009, 12(2):107-112.
7. Razak F, Finlay JE, Subramanian S: Maternal underweight and child growth and development. *The Lancet* 2013, 381(9867):626-627.
8. Food, Nations AOotU: The State of Food Security and Nutrition in the World: Safeguarding Against Economic Slowdowns and Downturns: FAO; 2019.
9. Egal F: Review of The State of Food Security and Nutrition in the World, 2019. *World Nutrition* 2019, 10(3):95-97.
10. Chaparro C, Oot L, Sethuraman K: Overview of the nutrition situation in seven countries in Southeast Asia. *Food and Nutrition Technical Assistance III Project (FANTA): Washington, DC, USA* 2014.
11. Sarwar T, Reja S, Akter N: Nutritional status of pregnant women in selected rural and urban area of Bangladesh. *Nutrition & Food Sciences* 2013.
12. Black R, Bhutta Z, Bryce J, Morris S, Victora C: The Lancet's Series on Maternal and Child Undernutrition. *The Lancet* 2013, 2013:1-12.
13. Haileslassie K, Mulugeta A, Girma M: Feeding practices, nutritional status and associated factors of lactating women in Samre Woreda, South Eastern Zone of Tigray, Ethiopia. *Nutrition journal* 2013, 12(1):28.
14. Ayana G, Hailu A, Tessema M, Belay A, Zerfu D, Bekele T, Kuche D, Eshetu S, Beyene Y, Mengistu G *et al*: Ethiopian National Nutrition Program End-Line Survey; 2015.
15. Duko B, Gebrie M, Hailu D: Factors associated with nutritional status among lactating mothers at Shashemene Woreda, West Arsi Zone, Oromia, Ethiopia: A comparative cross-sectional study. *International Journal of Nutrition and Metabolism* 2018, 10(6):37-46.
16. Roba KT, O'Connor TP, Belachew T, O'Brien NM: Anemia and undernutrition among children aged 6-23 months in two agroecological zones of rural Ethiopia. *Pediatric health, medicine and therapeutics*

- 2016, 7:131-140.
17. Hasnat Milton A, Smith W, Rahman B, Ahmed B, Shahidullah S, Hossain Z, Hasan Z, Sharmin S: Prevalence and determinants of malnutrition among reproductive aged women of rural Bangladesh. *Asia Pacific Journal of Public Health* 2010, 22(1):110-117.
 18. Desyibelew HD, Dadi AF: Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis. *PloS one* 2019, 14(9):e0221712.
 19. Mukunya D, Mutisya LM, Musaba M, Kagwisagye M, Kato IA, Tuke R, Habumugisha T, Kawuki J: Underweight and associated factors among lactating women in Uganda: evidence from the Uganda demographic health survey 2016. 2020.
 20. Resolution A: RES/70/1. Transforming our world: the 2030 agenda for sustainable development. *Seventieth United Nations General Assembly, New York* 2015, 25.
 21. Moher D, Liberati A, Tetzlaff J, Altman DG: Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine* 2009, 151(4):264-269, w264.
 22. Peterson J, Welch V, Losos M, Tugwell P: The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. *Ottawa: Ottawa Hospital Research Institute* 2011.
 23. Sterne JA, Egger M: Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. *Journal of clinical epidemiology* 2001, 54(10):1046-1055.
 24. Egger M, Smith GD, Schneider M, Minder C: Bias in meta-analysis detected by a simple, graphical test. *Bmj* 1997, 315(7109):629-634.
 25. Higgins JP, Thompson SG, Deeks JJ, Altman DG: Measuring inconsistency in meta-analyses. *Bmj* 2003, 327(7414):557-560.
 26. Borenstein M, Hedges LV, Higgins JP, Rothstein HR: Fixed-effect versus random-effects models. *Introduction to Meta-analysis* 2009, 77:85.
 27. Patsopoulos NA, Evangelou E, Ioannidis JP: Sensitivity of between-study heterogeneity in meta-analysis: proposed metrics and empirical evaluation. *International journal of epidemiology* 2008, 37(5):1148-1157.
 28. Bown MJ, Sutton AJ: Quality Control in Systematic Reviews and Meta-analyses. *European Journal of Vascular and Endovascular Surgery* 2010, 40(5):669-677.
 29. Marušić MF, Fidahić M, Cepeha CM, Farçaş LG, Tseke A, Puljak L: Methodological tools and sensitivity analysis for assessing quality or risk of bias used in systematic reviews published in the high-impact anesthesiology journals. *BMC Medical Research Methodology* 2020, 20(1):121.
 30. Gebre B, Biadgilign S, Taddese Z, Legesse T, Letebo M: Determinants of malnutrition among pregnant and lactating women under humanitarian setting in Ethiopia. *BMC nutrition* 2018, 4(1):11.
 31. Serbesa ML, Iffa MT, Geleto M: Factors associated with malnutrition among pregnant women and lactating mothers in Miesso Health Center, Ethiopia. *Eur J Midwifery* 2019, 3:1-5.

32. Haidar JA, Muroki NM, Omwega AM, Ayana G: Malnutrition and iron deficiency in lactating women in urban slum communities from Addis Ababa, Ethiopia. *East African medical journal* 2003, 80 4:191-194.
33. Zerihun E, Egata G, Mesfin F: Under nutrition and its associated factors among lactating mothers in rural Ambo district, west Shewa zone, Oromia region, Ethiopia. *East African Journal of Health and Biomedical Sciences* 2016, 1(1):39-48.
34. Julla BW, Haile A, Ayana G, Eshetu S, Kuche D, Asefa T: Chronic Energy Deficiency and Associated Factors among Lactating Mothers (15-49 years old) in Offa Woreda, Wolayita Zone, SNNPRs, Ethiopia. *World Scientific Research* 2018, 5(1):13-23.
35. Alemayehu M, Argaw A, Mariam AG: Factors Associated With Malnutrition Among Lactating Women In Subsistence Farming Households From Dedo And Seqa-Chekorsa Districts, Jimma Zone, 2014. *Developing Country Studies* 2015, 5(21):117-118.
36. Sitotaw IK, Haillesslasie K, Adama Y: Comparison of nutritional status and associated factors of lactating women between lowland and highland communities of District Raya, Alamata, Southern Tigray, Ethiopia. *BMC nutrition* 2017, 3(1):61.
37. Tikuye HH, Gebremedhin S, Mesfin A, Whiting S: Prevalence and factors associated with undernutrition among exclusively breastfeeding women in Arba Minch Zuria District, Southern Ethiopia: A cross-sectional community-based study. *Ethiopian journal of health sciences* 2019, 29(1).
38. Hundera TD, Gemedede HF, Wirtu D, Kenie DN: Nutritional status and associated factors among lactating mothers in Nekemte Referral Hospital and Health Centers, Ethiopia. *Int J Nutr Food Sci* 2015, 4(2):216-222.
39. Bekele H, Jima GH, Regesu AH: Undernutrition and associated factors among lactating women: Community-based cross-sectional study in Moyale District, Borena Zone, Southern Ethiopia. *Advances in Public Health* 2020, 2020.
40. Desalegn BB, Lambert C, Riedel S, Negese T, Biesalski HK: Ethiopian Orthodox Fasting and Lactating Mothers: Longitudinal Study on Dietary Pattern and Nutritional Status in Rural Tigray, Ethiopia. *International journal of environmental research and public health* 2018, 15(8).
41. Kibr G: Nutritional status and associated drivers of food choice among lactating women in Debre Birhan Town, North Shoa Zone, Amhara Region, Ethiopia: A community based cross-sectional study. *International Journal of Nutrition and Metabolism* 2020, 12(2):16-24.
42. Engidaw MT, Gebremariam AD, Tiruneh SA, Asnakew DT, Abate BA: Chronic energy deficiency and its associated factors among lactating women in Debre Tabor general hospital, Northcentral Ethiopia. *Journal of Family Medicine and Health Care* 2019, 5(1):1-7.
43. Abeya S, Biru K, Jima A: Factors Associated with Underweight among Lactating Mothers in Adama District, Oromia Region, Ethiopia. *J Orthop Bone Res 1: 101 Abstract Keywords: Lactating Women* 2018.
44. Kejela G, Gebremeskel F, Hassen H, Shewangizaw M, Desalegn M: Under Nutrition and associated factors among lactating mothers in Southern Ethiopia: Institution Based Cross-sectional study. 2019.

45. Marías Y, Glasauer P: Guidelines for assessing nutrition-related knowledge, attitudes and practices: Food and Agriculture Organization of the United Nations (FAO); 2014.
46. Ongosi AN: Nutrient intake and nutrition knowledge of lactating women (0-6) months postpartum) in a low socio-economic area in Nairobi, Kenya. University of Pretoria; 2011.
47. Mardani M, Abbasnezhad A, Ebrahimzadeh F, Roosta S, Rezapour M, Choghakhori R: Assessment of nutritional status and related factors of lactating women in the urban and rural areas of Southwestern Iran: A population-based cross-sectional study. *International Journal of Community Based Nursing and Midwifery* 2020, 8(1):73.
48. Koletzko B, Brands B, Poston L, Godfrey K, Demmelmair H: Early nutrition programming of long-term health. *Proceedings of the Nutrition Society* 2012, 71(3):371-378.
49. Brands B, Demmelmair H, Koletzko B, Project E: How growth due to infant nutrition influences obesity and later disease risk. *Acta Paediatrica* 2014, 103(6):578-585.
50. Koletzko B, Brands B, Grote V, Kirchberg FF, Prell C, Rzehak P, Uhl O, Weber M, Project ENP: Long-term health impact of early nutrition: the power of programming. *Annals of Nutrition and Metabolism* 2017, 70(3):161-169.
51. Teshome T, Singh P, Moges D: Prevalence and associated factors of overweight and obesity among high school adolescents in urban communities of Hawassa, Southern Ethiopia. *Current Research in Nutrition and Food Science Journal* 2013, 1(1):23-36.
52. Mardani M, Abbasnezhad A, Ebrahimzadeh F, Roosta S, Rezapour M, Choghakhori R: Assessment of Nutritional Status and Related Factors of Lactating Women in the Urban and Rural Areas of Southwestern Iran: A Population-Based Cross-Sectional Study. *International journal of community based nursing and midwifery* 2020, 8(1):73-83.
53. Nakamori M, Ninh NX, Isomura H, Yoshiike N, Hien VTT, Nhug BT, Nhien NV, Nakano T, Khan NC, Yamamoto S: Nutritional Status of Lactating Mothers and Their Breast Milk Concentration of Iron, Zinc and Copper in Rural Vietnam. *Journal of Nutritional Science and Vitaminology* 2009, 55(4):338-345.
54. Khan YM, Khan A: A Study on factors influencing the Nutritional Status of Lactating Women in Jammu, Kashmir and Ladakh Regions. *IJART* 2012, 1(4):65-74.
55. Madanijah S, Rimbawan R, Briawan D, Zulaikhah Z, Andarwulan N, Nuraida L, Sundjaya T, Murti L, Bindels J: Nutritional status of lactating women in Bogor district, Indonesia: cross-sectional dietary intake in three economic quintiles and comparison with pre-pregnant women. *British Journal of Nutrition* 2016, 116(S1):S67-S74.
56. Organization WH: Global nutrition policy review: what does it take to scale up nutrition action?: World Health Organization; 2013.
57. World Health Organization: Nutrition in the WHO African Region. 2017.
58. Birara E, Mequanent M, Samuel T: Assessment of food security situation in Ethiopia. *World Journal of Dairy & Food Sciences* 2015, 10(1):37-43.

59. FAO A: Gender Equality and Food Security–Women’s empowerment as a Tool against Hunger. Mandaluyong City, Philippines: ADB. 2013.
60. Pal A, Pari AK, Sinha A, Dhara PC: Prevalence of undernutrition and associated factors: A cross-sectional study among rural adolescents in West Bengal, India. *International Journal of Pediatrics and Adolescent Medicine* 2017, 4(1):9-18.
61. Berhe K, Kidanemariam A, Gebremariam G, Gebremariam A: Prevalence and associated factors of adolescent undernutrition in Ethiopia: a systematic review and meta-analysis. *BMC nutrition* 2019, 5(1):49.
62. Haseen F: Malnutrition among ultra poor women in Bangladesh: Malnutrition among Bangladeshi women in ultra poor households: Prevalence and determinants. 2010.
63. Kshatriya GK, Acharya SK: Gender disparities in the prevalence of undernutrition and the higher risk among the young women of Indian tribes. *PloS one* 2016, 11(7):e0158308.
64. Institute EPH, ICF: Ethiopia mini demographic and health survey 2019: key indicators. In.: EPHI and ICF Rockville, Maryland, USA; 2019.

Tables

Table 1: Summary of the included articles to assess the prevalence of undernutrition and associated factors among lactating mothers in Ethiopia, 2020 (n=16)

Author's name	Year	Study Design	Region	Sample size	Sampling technique	Prevalence (%)	Quality score
Tadege et al	2019	Cross sectional	Amhara	266	Systematic	17.9	7
Biru et al	2017	Cross sectional	Oromia	662	Simple	19.5	6
Wodajo et al	2018	Cross sectional	SNNP	422	Simple	15.8	7
Alemayehu et al	2015	Cross sectional	Oromia	355	Census	40.6	6
Hailelassie et al	2013	Cross sectional	Tigray	400	Simple	25.0	8
Duko et al	2018	Cross sectional	Oromia	484	Simple	5.6	7
Kalayu et al	2017	Cross sectional	Tigray	464	stratified	21.2	8
Hassen et al	2018	Cross sectional	SNNP	478	Multi-stage	17.4	7
Desisa et al	2015	Cross sectional	Oromia	317	Simple	20.0	6
Bekele et al	2020	Cross sectional	Oromia	545	Systematic	17.7	10
Berhanu et al	2018	Longitudinal	Tigray	575	Multi-stage	33.6	8
Kibr et al	2020	Cross sectional	Amhara	423	Simple	21.7	6
Zerihun et al	2016	Cross sectional	Oromia	638	Simple	21.5	8
Kejela et al	2019	Cross sectional	SNNP	445	Systematic	26.1	6
Roba et al	2016	Cross sectional	T&O	216	Simple	54.7	9
Haidar et al	2003	Cross sectional	AA	1140	Simple	27.1	7

Hint: T&O- Tigray and Oromia, **SNNP:** South nation nationalities and people, **AA:** Addis Ababa, Quality score was out of 10.

Table 2: Subgroup analysis findings on prevalence of undernutrition among Lactating women in Ethiopia, 2020 (n=16)

Variables	Characteristics	No. of studies	Prevalence (95% CI)	Heterogeneity	
				I ² (%)	P value
Region	Oromia	6	20.66 (12.21,29.10)	97.6	P<0.001
	SNNP	3	19.67 (13.78,25.55)	87.2	P<0.001
	Tigray	3	26.60 (19.2, 34.0)	90.5	P<0.001
	Amhara	2	20.04 (16.35, 23.74)	31.6	0.226
	Addis Ababa	1	27.1 (24.37, 29.83)	-	-
	Tigray & Oromia	1	54.7 (47.85, 61.55)	-	-
Publication year	2017 and before	8	28.27 (22.33, 34.21)	94.8	P<0.001
	After 2017	8	19.41 (12.8, 26.02)	96.7	P<0.001
Design type	Institutional Based	4	23.02 (18.59, 27.45)	80.6	P<0.001
	Community based	12	24.26 (18.12, 30.41)	97.3	P<0.001
Overall pooled prevalence of undernutrition			23.86% (19.01, 28.72)	96.7	p < 0.001

Figures

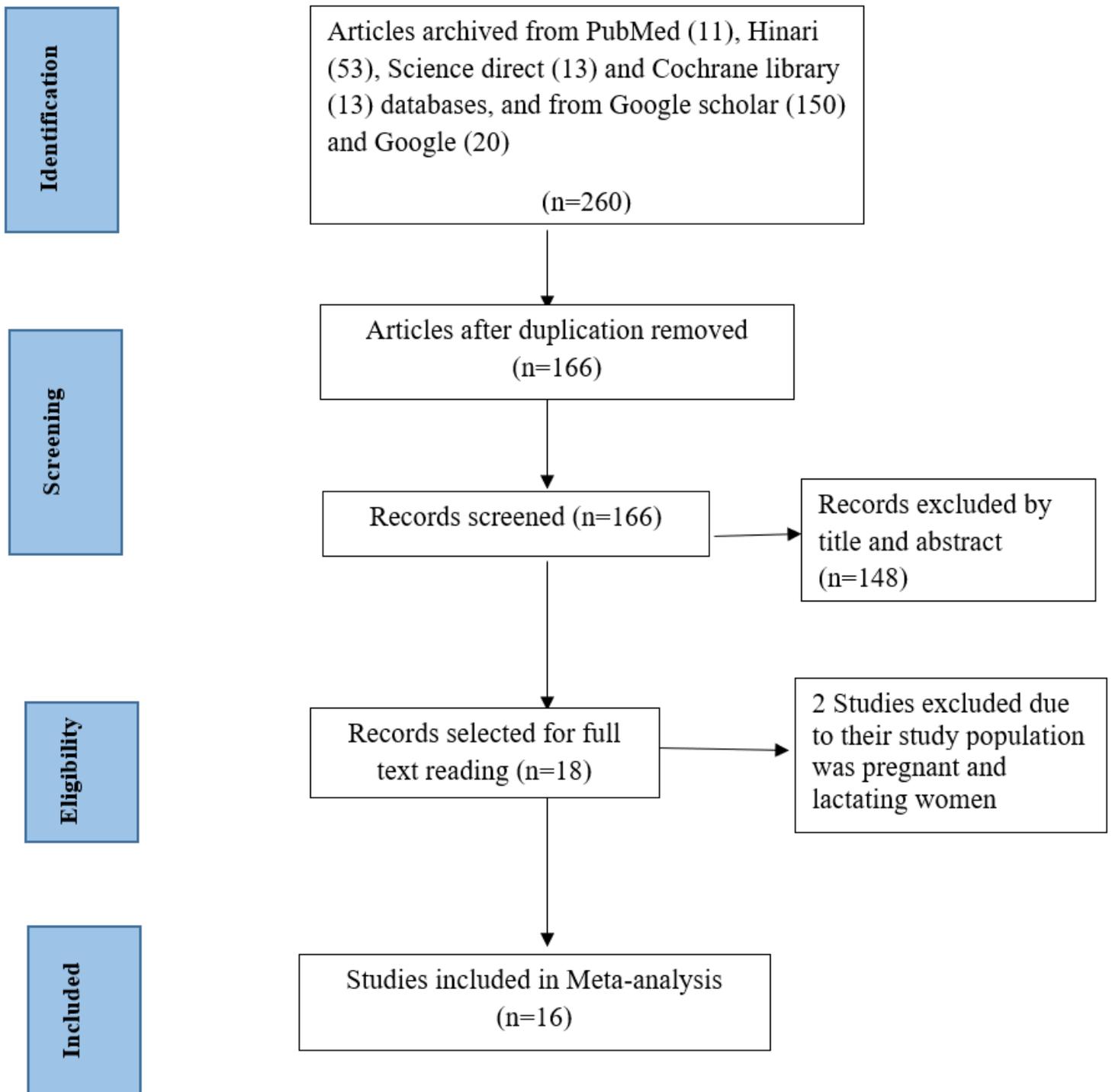


Figure 1

Flow diagram of the studies included in the review of lactating women undernutrition in Ethiopia, 2020

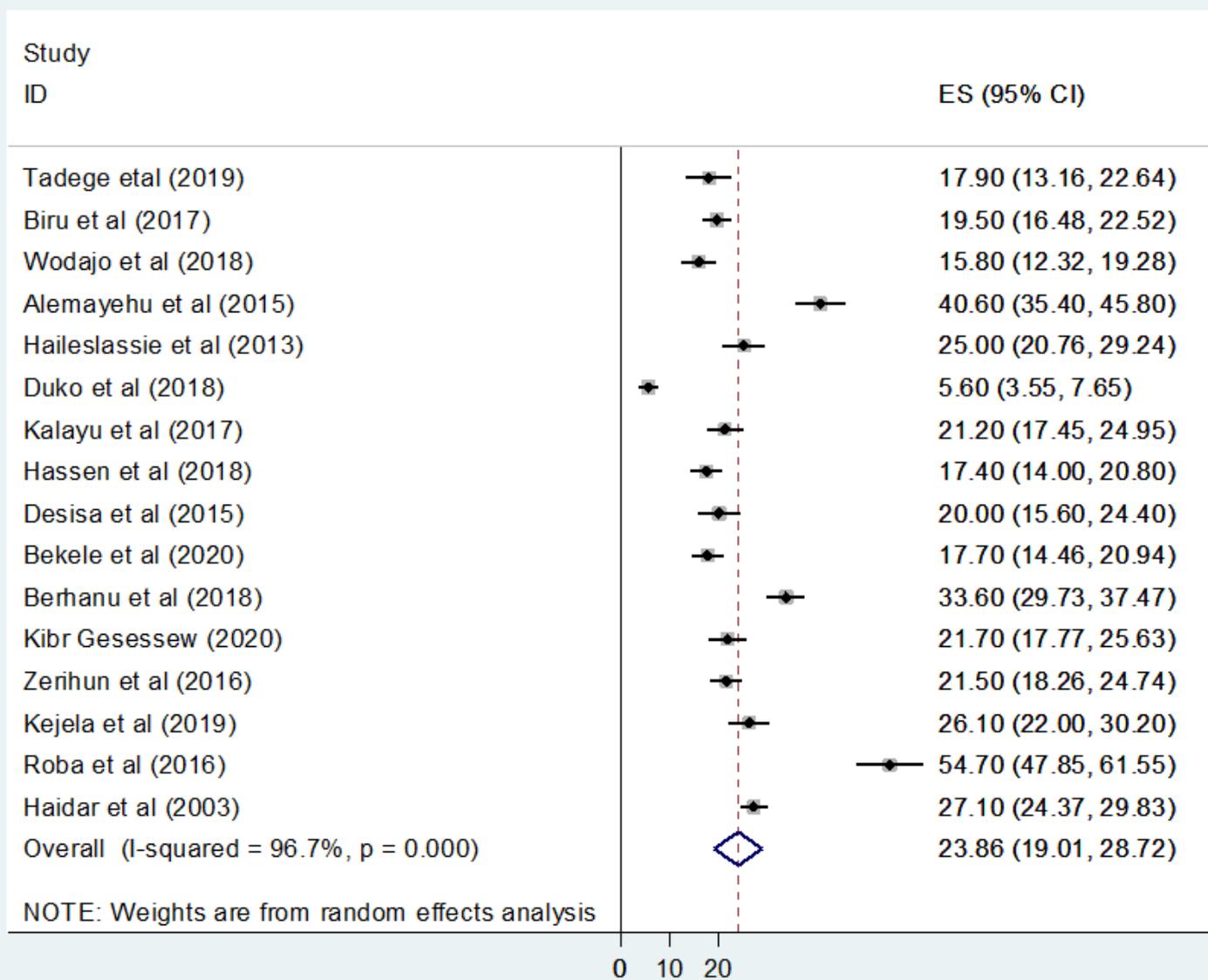


Figure 2

The pooled prevalence of lactating mother's undernutrition and its 95% CI in Ethiopia, 2020

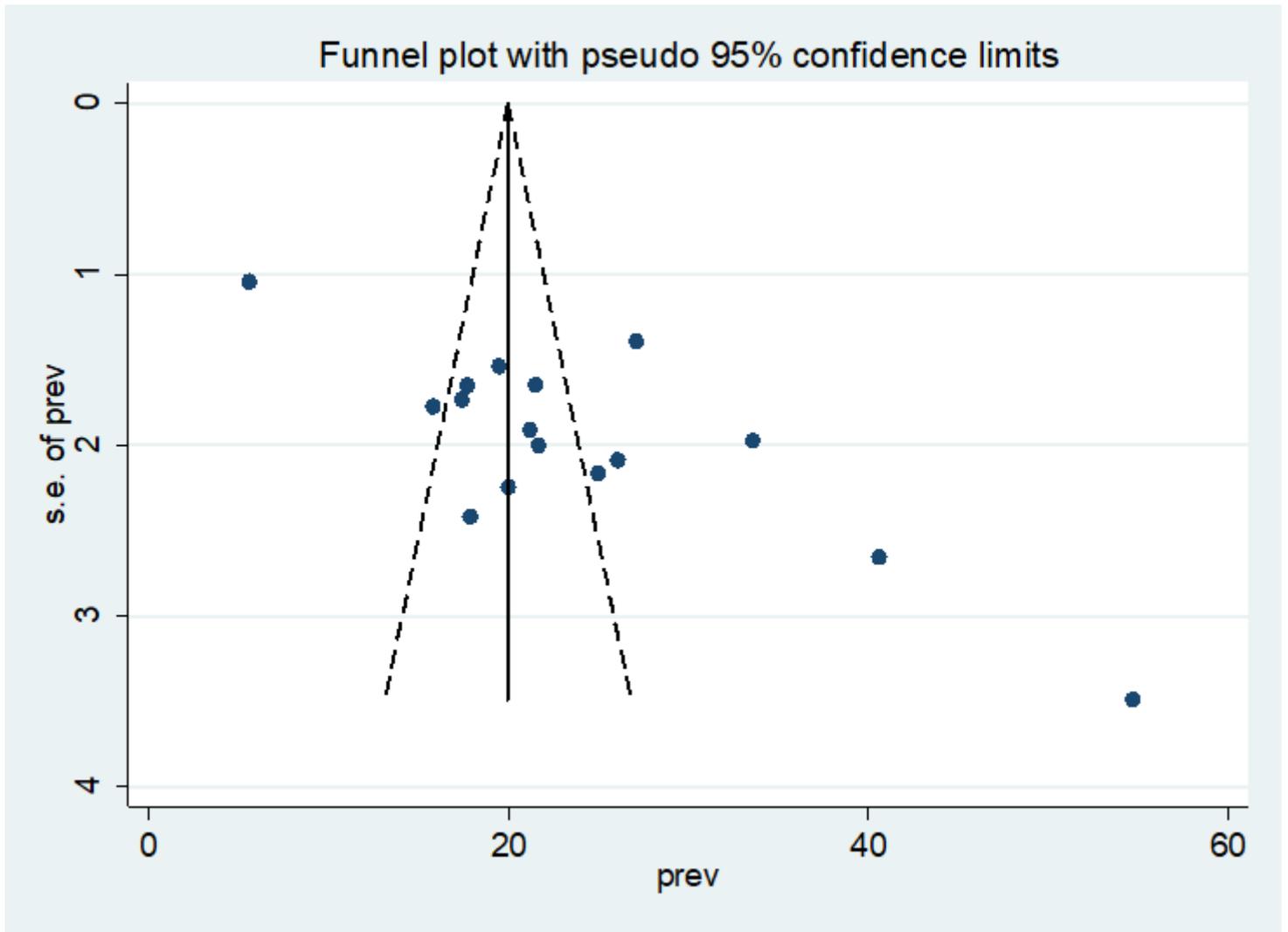


Figure 3

Funnel plot to assess publication bias for lactating mother's undernutrition in Ethiopia, 2020

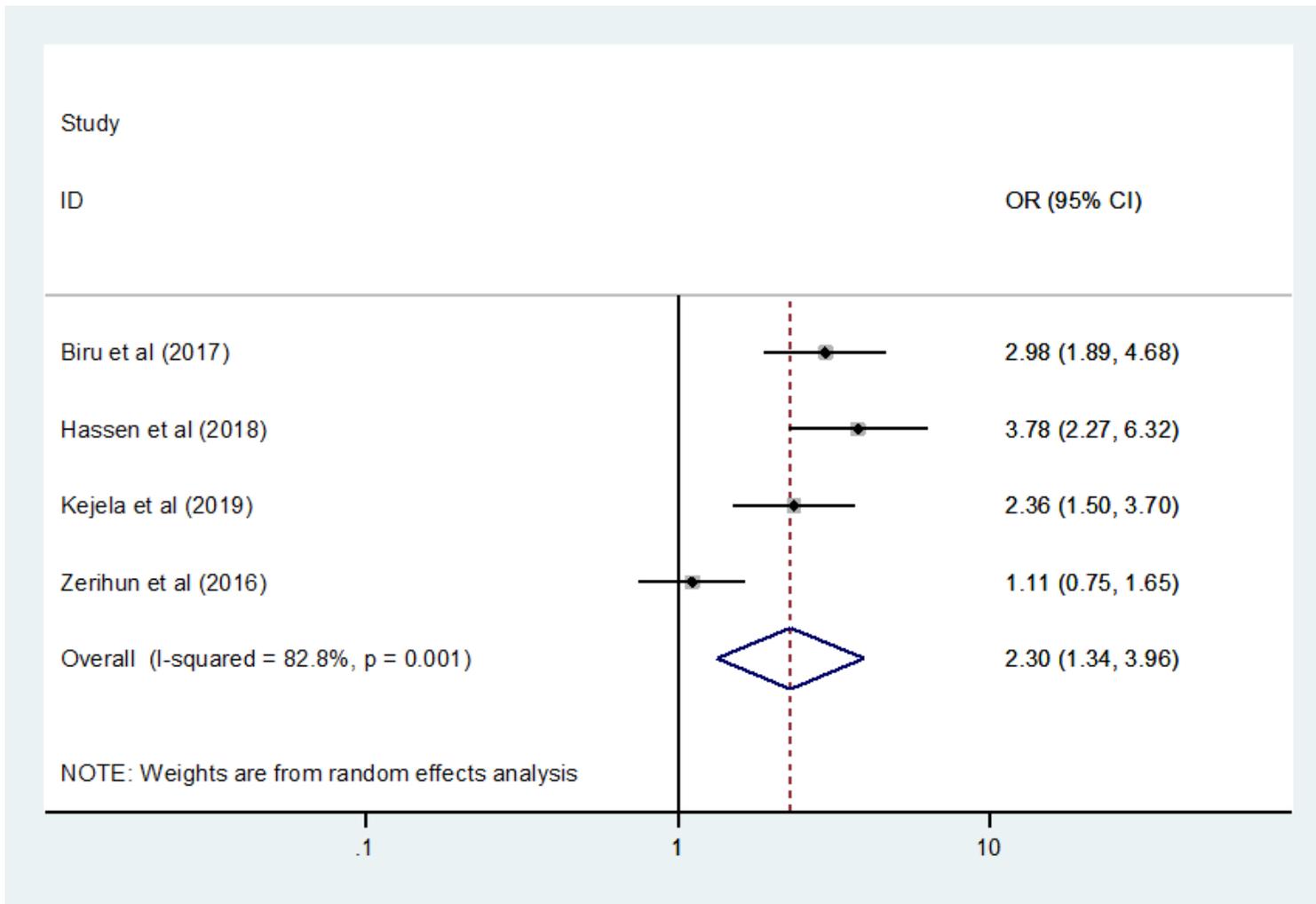


Figure 4

Association between maternal education status and undernutrition among lactating mothers in Ethiopia, 2020

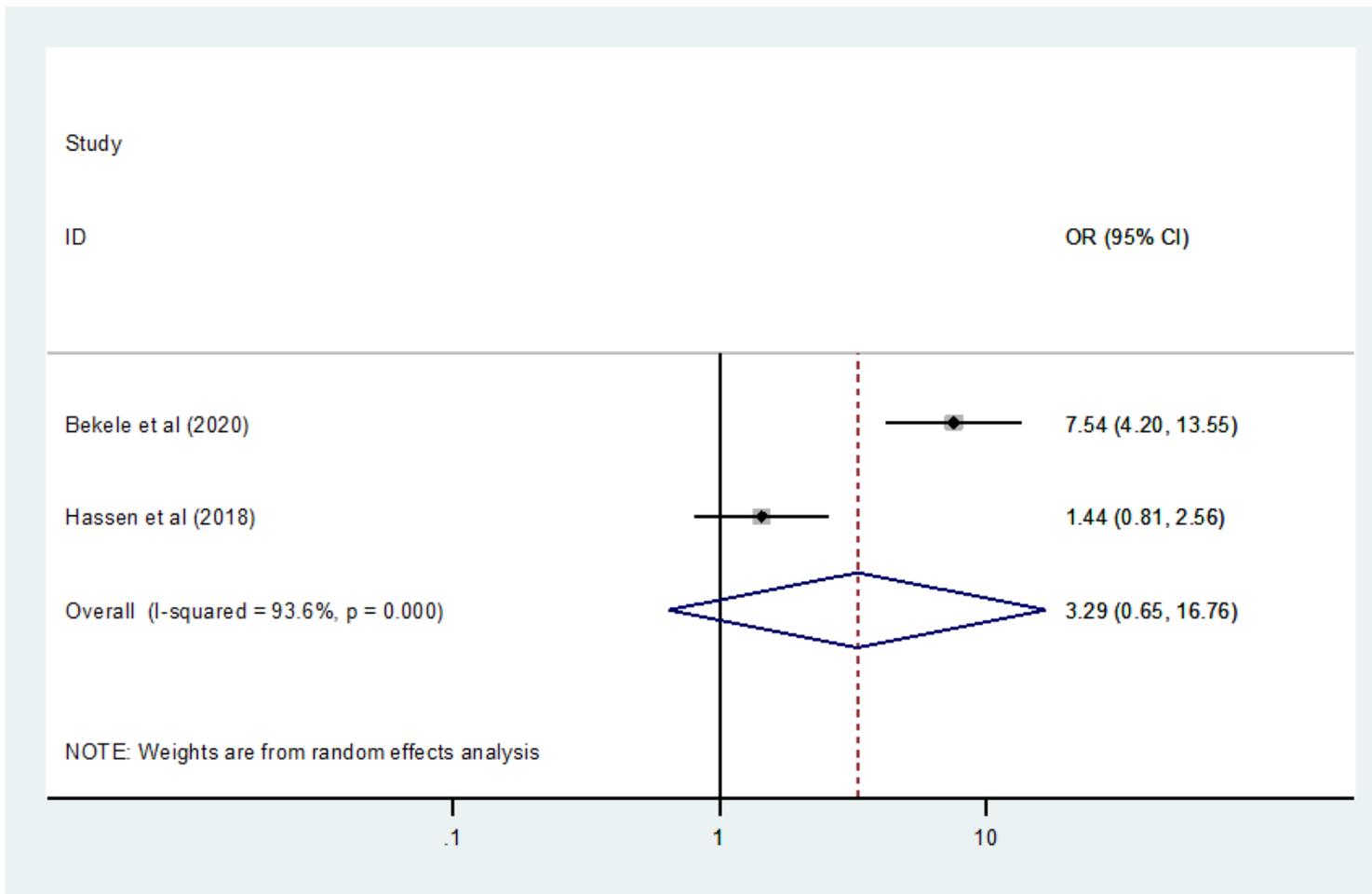


Figure 5

Association between household food insecurity and undernutrition among lactating mothers in Ethiopia, 2020

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