Under-Nutrition and Associated Factors Among Lactating Mothers in Ethiopia: A Systematic Review and Meta-analysis

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Abstract

Introduction Under-nutrition (body mass index < 18.5 kg/m²) is a global problem with an increasing trend in recent years. The burden is high in low and middle-income countries, especially in Africa. Lactating mothers are among the most vulnerable groups for under nutrition; particularly in sub-Saharan Africa. In Ethiopia, the prevalence of under-nutrition among this group is inconsistent and inconclusive. Therefore, we aimed to assess the pooled prevalence of under-nutrition 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 review and meta-analysis guidelines. Primary articles were searched from PubMed, Hinari, Cochrane Library, science direct databases, Google, and Google scholar. STATA version 16 software and a standardized Microsoft excel format were used for analysis and data extraction, respectively. Heterogeneity between studies was checked. To determine the pooled prevalence of under-nutrition, we used a random-effect model. Begg’s and Egger’s tests were done to detect publication bias. Subgroup analysis was also steered and association was uttered by a pooled odds ratio with 95% CI.

Results The pooled prevalence of under-nutrition among lactating mothers was 23.84% [95% CI (19.40, 28.27)]. Educational status (no formal education) {Pooled OR 2.30 [95% CI (1.34, 3.96)]} was significantly associated with under-nutrition.

Conclusion The pooled prevalence of under-nutrition was high. Maternal educational status was significantly associated with under-nutrition. Therefore, the federal ministry of health and the concerned stakeholders should give attention to these most vulnerable groups and strengthen the implementation of the previously designed strategies.

Keywords Lactating mothers · Under nutrition · Factors · Ethiopia · Meta-analysis

Significance Statement

Several single studies were conducted in low and middle-income countries including Ethiopia on under-nutrition. In Ethiopia, a strategic plan under the National Nutrition Program (NNP) by the year 2015 was designed to drop the prevalence of under-nutrition from 27 to 19 percent. However, the plan is not achieved yet, and the prevalence of under-nutrition among lactating mothers is inconsistent and inconclusive. Therefore, to support the 2030 Sustainable developmental plan achievement, conducting this type of summarized review is helpful. Therefore, we aimed to conduct this study in Ethiopia.
Background

Nutrition is a vital indicator of the complete health of a population and a pillar of development (Daba et al., 2013). Under-nutrition is more prevalent among children and women, especially in lactating and pregnant mothers. Under-nutrition is responsible for 3.5 million maternal and children deaths, 35% of children’s disease burden, 20% of maternal mortality, and 11% of daily-adjusted life-years (DALYs) (Black et al., 2008). Maternal under-nutrition is well-defined as having a body mass index (BMI) of < 18.5 kg/m² (Mtumwa et al., 2016).

During lactation, there is a high need for 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 (Victora et al., 2008). Also, it increases the risk of under-five mortality and morbidity (Demissie et al., 2003; Razak et al., 2013; Sanusi & Falana, 2009).

Maternal under-nutrition is a serious public problem, but more prevalent in sub-Saharan Africa, south-central, and southeastern Asia countries (Food & Agriculture Organization of the United Nations, 2019). In 2018, 10.8% of the world population were under-nourished, 19.9% in Africa (Egal, 2019). In the globe, the prevalence of underweight among women ranges from 10 to 19% (Black et al., 2008). In Sub-Saharan African countries, 10–20% of women are under-nourished (Chaparro et al., 2014). 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 in pre-pregnancy and pregnancy periods (Sarwar et al., 2013). Lactating mothers in low-income countries, are more vulnerable to under-nutrition, especially in South East Asia and sub-Saharan Africa (Black et al., 2013; Haileslassie et al., 2013). In Ethiopia, the prevalence of under-nutrition among women 20.6% (Ayana et al., 2015) and the prevalence of under-nutrition among lactating mothers ranges from 5.6 to 54.7% (Duko et al., 2018; Roba et al., 2016). Consequently, providing summarized evidence is important for policymakers to revise their strategies, strengthen the implementation of the designed interventions and achieve the global sustainable development plan goals 2.2 and 3.1 (Resolution, 2015). Therefore, this systematic review and meta-analysis 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 similar systematic reviews to avoid duplication using the website https://www2. le.ac.uk/library/find/databases/p/Prospero. Primary articles were searched from PubMed, Hinari, Science Direct, and Cochrane library databases. Moreover, grey literatures were retrieved from Google and Google scholar. Furthermore, the reference lists of published articles were searched to recognize other relevant articles that did not show in databases. To decrease the number of unrelated studies during the search process, the search was restricted to only ‘human studies’, and ‘women/mothers’ in the advanced search. The searching of primary articles was started on June 26, 2020, and ended on 30 April 2021. We used “Under-nutrition 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. This systematic review and meta-analysis included both published and unpublished articles that fulfill the eligibility criteria. During writing this review and meta-analysis, we used the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). Articles were downloaded into Endnote version X7 to maintain and manage citations, facilitate the review process, and check the duplication of articles.

Inclusion and Exclusion Criteria

All observational studies (cross-sectional, case–control and cohort studies) conducted in Ethiopia among lactating mothers were included. Moreover, articles reporting the prevalence of under-nutrition (BMI < 18.5 kg/m²) and/or associated factors were included. Both published and unpublished full articles were considered. Both institutional and community-based studies were encompassed. Studies conducted among both lactating and pregnant mothers were excluded. 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.

**Outcome Measures**

This systematic review and meta-analysis has two objectives. The first was to estimate the pooled prevalence of under-nutrition among lactating mothers in Ethiopia, calculated by dividing the number of lactating mothers with this problem by 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 kg/m²) to assess under-nutrition among lactating mothers. The second objective was to determine the pooled effects of factors on under-nutrition. In this systematic review and meta-analysis, variables identified as a factor in two and above studies were included in this meta-analysis. To express the pooled effects, we used the odds ratio (OR), calculated from the 2 x 2 table.

**Quality Assessment and Data Extraction**

Newcastle Ottawa Scale was used to assess the quality of the included studies (Peterson et al., 2011). 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 assessing lactating mothers under-nutrition status, measures to identify under-nutrition, and covariates included in statistical models. The tool comprised ten standards for rating different quality elements. After quality assessment, studies with high quality (scored six and above out of ten) were included into analysis. During quality assessment, any discrepancies were solved through discussion, by taking the average result of the two appraisers and by giving the decision for the remaining two authors.

The necessary data were extracted separately using a standardized Microsoft Excel data extraction format by two authors (BG and JN). We used two data extraction formats, one for each objective. For example, for the prevalence of under-nutrition the data extraction format comprised author name, publication year, the studies region/country, study design, sample size, response rate, outcome measurement tool, study quality score, and prevalence of under-nutrition. We also used two-by-two tables to extract data for objective two. During the data extraction period, any incongruities between the two authors (BG and JN) were resolved through twofold checking the variable data together, and third author invitation.

**Publication Bias and Heterogeneity**

Both methods assessed publication bias, funnel plots, the subjective method used to test for asymmetry (Sterne & Egger, 2001), and Egger’s statistical test (Egger et al., 1997). To declare publication bias’s statistical significance, we used a P-value < 0.05. After a comprehensive examination of the included studies, the heterogeneity of the studies was assessed by I² test statistics. I² statistics described the total variation across studies and declared low, moderate, and high heterogeneity if it is < 50, 50–75%, and > 75%, respectively (Higgins et al., 2003).

**Statistical Method and Analysis**

We extracted essential data from each study using Microsoft Excel spreadsheet, and the data were exported to STATA software version 16 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 under-nutrition and OR of the associated factors. We used a random-effect model for analysis (Borenstein et al., 2009). To check the source of heterogeneity, we conducted a leave-one study-out sensitivity analysis and subgroup analysis (Bown & Sutton, 2010; Marušić et al., 2020; Patsopoulos et al., 2008). 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**

**Searching Strategy and Study Selection**

The algorithm used for this review and meta-analysis yielded 262 primary articles, extracted from PubMed, Hinari, Cochrane library, science direct databases, and Google Scholar and Google. Of which, 148 articles were excluded due to duplication and during title and abstract screening. A total of 20 articles were selected for full article reading and 2 records were additionally removed due to there were conducted in lactating and pregnant mothers together (Gebre et al., 2018; Serbesa et al., 2019). Lastly, 18 articles were selected for the final review and meta-analysis (Abeya et al., 2018; Alemayehu et al., 2015; Bekele et al., 2020; Berihun et al., 2017; Boke et al., 2021; Desalegn et al., 2018; Duko et al., 2018; Engidaw et al., 2019; Haider et al., 2003; Haileslassie et al., 2013; Hundera et al., 2015; Julla et al., 2018; Kibr, 2020; Roba et al., 2016; Sitotaw et al., 2017; Tikuye et al., 2019; Zerihun et al., 2016) (Fig. 1).

**Study Characteristics and Systematic Review**

Except one study (Desalegn et al., 2018), all included articles were cross-sectional studies. The study was conducted
among 8912 Ethiopian lactating mothers. In this review and meta-analysis, the included articles had a sample size ranging from 216 (Roba et al., 2016) to 1140 (Haidar et al., 2003). Ten (55.5%) of the included studies used a simple random sampling technique (Abeya et al., 2018; Boke et al., 2021; Duko et al., 2018; Haidar et al., 2003; Haileslassie et al., 2013; Hundera et al., 2015; Julla et al., 2018; Kibr, 2020; Roba et al., 2016; Zerihun et al., 2016). Nine (50%) of the included studies were conducted in 2018 and then after (Abeya et al., 2018; Bekele et al., 2020; Boke et al., 2021; Desalegn et al., 2018; Duko et al., 2018; Engidaw et al., 2019; Julla et al., 2018; Kejela et al., 2019; Kibr, 2020; Sitotaw et al., 2017; Tikuye et al., 2019). Single study were conducted before 2010 (Haidar et al., 2003). Regarding the region where the study conducted 6 (33.3%) were from Oromia (Abeya et al., 2018; Alemayehu et al., 2015; Bekele et al., 2020; Duko et al., 2018; Hundera et al., 2015; Zerihun et al., 2016), four were from SNNP (Boke et al., 2021; Julla et al., 2018; Kejela et al., 2019; Tikuye et al., 2019), three were from Tigray (Desalegn et al., 2018; Haileslassie et al., 2013; Sitotaw et al., 2017), three were from Amhara (Berenhun et al., 2017; Engidaw et al., 2019; Kibr, 2020) and two were from Addis Ababa (Haidar et al., 2003), and Tigray and Oromia regions (Roba et al., 2016) together.

The highest prevalence of under nutrition among lactating mothers was reported from a study done in Tigray and Oromia region jointly (54.7%) (Roba et al., 2016) and the least was from the Oromia region (5.6%) (Duko et al., 2018) (Table 1).
Prevalence of Under-Nutrition Among Lactating Women

To estimate the pooled prevalence of under-nutrition among lactating mothers, eighteen studies were included. The heterogeneity seen between studies included in this review was high ($I^2 = 95.76\%$ and $P < 0.001$). Due to this heterogeneity, we used random-effects model to estimate the pooled prevalence of under-nutrition, 23.84 [95% CI (19.40, 28.27)] (Fig. 2).

In this review and meta-analysis, publication bias was confirmed by Egger’s test ($P: 0.001$) and unsymmetrical Funnel plot (Fig. 3). But after we removed the highly varying two studies (Duko et al., 2018; Roba et al., 2016), the pooled prevalence of under-nutrition was 23.16 [95% CI (20.09, 26.22)], and the result of Begg’s and Egger’s test results was $P: 0.62$ and $P: 0.12$, respectively.

Subgroup analysis was done by region, publication year, sampling technique and design type. Thus, the estimated pooled prevalence of under-nutrition 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 20.02 [95% CI (15.57, 24.47)]. The minimum heterogeneity between studies was seen among studies conducted in Amhara region, Ethiopia ($I^2 = 72.09\%$ and $p < 0.226$). Studies conducted in 2017 and before had high heterogeneity ($I^2 = 96.86\%$; $p < 0.001$). Lastly, there was low heterogeneity ($I^2 = 82.84\%$; $P < 0.001$) between studies which selected there population with systematic random sampling techniques as compared to others techniques (Table 2).

Factors Associated with Under-Nutrition Among Lactating Mothers

In this review and meta-analysis, we included significant factors at least in two primary studies. Dietary diversity, food insecurity, maternal educational status, age, family income, postnatal care service, and family size were significant factors for under-nutrition. However, only food insecurity and educational status were held all the necessary data to construct 2 × 2 tables and reported with similar categories across studies. The remaining factors were reported with different types and didn’t have 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 their effect.

Table 1 Summary of the included articles to assess the prevalence of under-nutrition and associated factors among lactating mothers in Ethiopia, 2021 (n = 18)

| Author’s name (year) | Study design | Region | Sample size | Sampling technique | Prevalence (%) | Quality score |
|----------------------|--------------|--------|-------------|--------------------|----------------|---------------|
| Engidaw et al. (2019)| Cross sectional | Amhara | 266 | Systematic | 17.9 | 7 |
| Abeya et al. (2018)  | Cross sectional | Oromia | 662 | Simple | 19.5 | 6 |
| Julla et al. (2018)  | Cross sectional | SNNP | 422 | Simple | 15.8 | 7 |
| Alemayehu et al. (2015)| Cross sectional | Oromia | 355 | Census | 40.6 | 6 |
| Haileslassie et al. (2013)| Cross sectional | Tigray | 400 | Simple | 25.0 | 8 |
| Duko et al. (2018)  | Cross sectional | Oromia | 484 | Simple | 5.6 | 7 |
| Sitotaw et al. (2017)| Cross sectional | Tigray | 464 | stratified | 21.2 | 8 |
| Tikuye et al. (2019) | Cross sectional | SNNP | 478 | Multi-stage | 17.4 | 7 |
| Hundera et al. (2015) | Cross sectional | Oromia | 317 | Simple | 20.0 | 6 |
| Bekele et al. (2020) | Cross sectional | Oromia | 545 | Systematic | 17.7 | 10 |
| Desalegn et al. (2018) | Cross sectional | SNNP | 414 | Simple | 21.2 | 8 |
| Kib 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 |
| Boke et al. (2021)   | Cross sectional | SNNP | 414 | Simple | 21.2 | 8 |
| Berihan et al. (2017) | Cross sectional | Amhara | 668 | Systematic | 25.6 | 8 |

Hint T&O—Tigray and Oromia, SNNP south nation nationalities and people, AA Addis Ababa, Simple simple random sampling technique, systematic: random sampling technique, Multi-stage multi-stage random sampling technique, Stratified stratified random sampling technique. Quality score out of 10
CI (1.34, 3.96)}, and $I^2 = 82.8\%$ and $P: < 0.001$ (Fig. 4). However, there was no association between food insecurity and under-nutrition {OR 3.35 [95% CI (0.63, 17.76)]} (Fig. 5).

**Discussion**

This review and meta-analysis aimed to assess the pooled prevalence of under-nutrition and its associated factors among lactating mothers in Ethiopia. The pooled prevalence of under-nutrition was 23.84% [95% CI (19.40, 28.27)]. This finding was similar with studies done in seven African countries (12.6–31.9%), systematic review done in Africa (23.5%) (Desyibelew & Dadi, 2019), Iran (26.11%) (Mardani et al., 2020) and rural Vietnam (23.7%) (Nakamori et al., 2009). However, it was high as compared to studies done in Uganda (8.2%) (Mukunya et al., 2020), India (16.9%) (Khan & Khan, 2012), Bangladesh (16.1%) (Khan & Khan, 2012), Indonesia (9%) (Madanijah et al., 2016), Ethiopia among women (20.6%) (Ayana et al., 2015) and the global standard acceptable malnutrition rate (10%) (World
Health Organization, 2013). The reason might be lactating mothers are more vulnerable due to double the burden to meet the requirement of their and their child’s 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%) (World Health Organization, 2017). This might be due to improvement in service delivery quality in recent years in Ethiopia evidenced with high prevalence of undernutrition among studies done in 2017 and before.

This meta-analysis assessed the association of food insecurity and maternal educational status with the outcome variable. Even though Ethiopia is one of the food-insecure countries, and 10% of Ethiopian citizens are chronically food insecure (Birara et al., 2015). Although the finding of a review and meta-analysis done in Africa revealed that food insecurity is a significant factor for under-nutrition among women. In this study, food insecurity hadn’t any association with under-nutrition [OR 3.35 [95% CI (0.63, 17.76)]. This might be because of only two studies were included in this review and meta-analysis to check this fact.

In the present study, maternal educational status was identified as a significant factor for under-nutrition among lactating mothers. Illiterate lactating mothers had 2.3 times more risk for under-nutrition as compared to literate mothers [Pooled OR 2.30 [95% CI (1.34, 3.96)]. This finding was similar to the food and agriculture organization (FAO) study across countries (FAO & ADB, 2013), studies done in India (Pal et al., 2017), Uganda (Mukunya et al., 2020), and Tanzania (Mtumwa et al., 2016). Moreover, it was similar to a systematic review done on adolescents under-nutrition (Berhe et al., 2019). This might be because of that illiterate mothers have inadequate nutritional knowledge, low economic status, high household burden, and low decision-making ability which leads to low use of health care facilities, accessibility of nutritious food, and low health-promoting behaviour (Haseen, 2010; Kshatriya & Acharya, 2016).

Even though this study is a systematic review and meta-analysis, it has some limitations. Some of which were high heterogeneity across studies, publication bias and almost all of studies included in this review and meta-analysis were cross sectional which couldn’t show the temporal relationship between the outcome and independent variables.

### Conclusion

The pooled prevalence of under-nutrition among lactating mothers was high compared to the national and global figures. Maternal education status was identified as a significant predictor of under-nutrition. To decrease this burden, the federal ministry of health and stake holders should strengthen their follow-up on implementing the designed strategies for this particular group since they are more vulnerable among all women. Furthermore, since in Ethiopia, 40.4% of women are illiterate (Ethiopian Public Health Institute & ICF, 2019) long-term plan should be designed to increase the access to education for women. That was one of the goals of the global sustainable development plan,

### Table 2

| Variables                  | Characteristics | No. of studies | Prevalence (95% CI)       | Heterogeneity |
|----------------------------|----------------|----------------|---------------------------|---------------|
| Region                     |                |                |                           |               |
| Oromia                     |                | 6              | 21.03 (12.37, 26.69)      | 96.43 < 0.001 |
| SNNP                       |                | 4              | 20.02 (15.57, 24.47)      | 82.53 < 0.001 |
| Tigray                     |                | 3              | 26.60 (19.37, 33.83)      | 90.5 < 0.001  |
| Amhara                     |                | 3              | 21.99 (17.66, 26.32)      | 72.09 0.226   |
| Addis Ababa                |                | 1              | 27.1 (24.37, 29.83)       | –             |
| Tigray & Oromia            |                | 1              | 54.7 (45.44, 63.96)       | –             |
| Publication year            |                |                |                           |               |
| 2017 and before            |                | 9              | 27.90 (20.78, 35.02)      | 96.86 < 0.001 |
| After 2017                 |                | 9              | 20.04 (15.42, 24.66)      | 91.57 < 0.001 |
| Design type                |                |                |                           |               |
| Institutional based        |                | 4              | 23.02 (18.59, 27.45)      | 80.6 < 0.001  |
| Community based            |                | 14             | 24.18 (18.4, 29.96)       | 96.73 < 0.001 |
| Sampling technique         |                |                |                           |               |
| Simple                     |                | 10             | 23.00 (15.98, 30.02)      | 96.86 < 0.001 |
| Systematic                 |                | 4              | 21.87 (17.31, 26.44)      | 82.84 < 0.001 |
| Stratified                 |                | 1              | 40.60 (35.40, 45.80)      | –             |
| Multistage                 |                | 2              | 25.47 (9.60, 41.35)       | 97.37 < 0.001 |
| Census                     |                | 1              | 21.20 (17.45, 24.95)      | –             |
| Overall pooled prevalence of under-nutrition | | 18  | 23.84 (19.40, 28.27) | 95.76 < 0.001 |
NOTE: Weights are from random effects analysis

| Study                  | OR (95% CI)          |
|------------------------|----------------------|
| Tikuye et al (2017)    | 2.98 (1.89, 4.68)    |
| Abeya et al (2018)     | 3.78 (2.27, 6.32)    |
| Kejela et al (2019)    | 2.36 (1.50, 3.70)    |
| Zerihun et al (2016)   | 1.11 (0.75, 1.65)    |
| Overall (I-squared = 82.8%, p = 0.001) | 2.30 (1.34, 3.96) |

NOTE: Weights are from random effects analysis

Fig. 4 Association between maternal education status and under-nutrition among lactating mothers in Ethiopia, 2021

| Study                  | OR (95% CI)          |
|------------------------|----------------------|
| Bekele et al (2020)    | 7.84 (4.37, 14.06)   |
| Tikuye et al. (2019)   | 1.44 (0.81, 2.56)    |
| Overall (I-squared = 93.9%, p =< 0.001) | 3.35 (0.63, 17.76) |

NOTE: Weights are from random effects analysis

Fig. 5 Association between household food insecurity and under-nutrition among lactating mothers in Ethiopia, 2021
and it is essential to decrease the burden of under nutrition among lactating mothers.

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Data Availability The data included in this study is available and can be accessed by contacting the corresponding author through this email address: bekahegni@gmail.com or Bekahegni@du.edu.et.

Declarations

Competing Interests All authors declare that they have no competing interests.

Ethical Approval Not applicable.

Consent for Publication Not applicable.

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