Under Nutrition and associated factors among lactating mothers in Southern Ethiopia: Institution Based Cross-sectional study

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Abstract
Background Maternal Nutrition contributes significantly to the long term health of mothers and their children. Despite this importance, globally, about 795 million people are undernourished and women and their children are the most vulnerable groups. Objective the main aim of this study was to assess under nutrition and associated factors among lactating mothers in Arba Minch Zuria district, Southern Ethiopia.

Methods institution based cross-sectional study was used. Data was collected using interview administered questionnaire from a total of 441 lactating mothers. To get the required respondents, first health centers in Arba Minch Zuria district were selected by using lottery method and probability to population size was performed for each health center. Finally, eligible respondents were selected using systematic sampling method. The questionnaire was pretested and close supervision was undertaken during data collection to assure the quality of data. The collected data was entered using Epi data version 3.02 and exported to SPSS version 20.0 for analysis. Binary and multivariable logistic regression were conducted, and finally variables with p-value of <0.05 were considered as statistically significant predictors.

Results Prevalence of under nutrition in this study was 26.1%. Under nutrition is higher among mothers who are unable to read and write (AOR[95%CI]= 3.931[1.700,9.091]), mothers who experienced more than five numbers of pregnancies (AOR[95%CI]= 2.453[1.051, 5.728]), those with more than four members of family size (AOR[95%CI]= 2.289[1.171, 4.472]), those who live in the household with no toilet (AOR [95%CI] = 6.407[3.556, 11.545]) and those who have less than 4 antenatal care visits (AOR[95%CI]= 2.053[1.185, 3.559]).

Conclusions and Recommendations In this study, the magnitude of under nutrition among lactating women was high. So, nutrition based health information, education and communication is needed for mothers especially during pregnancy and lactation in the study area.

1. Background
Nutrition is a fundamental pillar of human life, health and development (1). Maternal nutrition during pregnancy and lactation influences the growth and development of the fetus. As a result, adequate
nutrition for the mothers during lactation is important for the health of mothers and their children (2). Lactating mothers from low-income countries are nutritionally vulnerable group. The maternal nutrition requirement varies with respect to age, income and physiological changes like pregnancy and lactation (1, 3).

Inadequate quality and quantity diet is one of the major reasons for high levels of malnutrition in pregnant and lactating women (4). Due to the nursing process, mothers are subjected to nutritional stresses and pregnancy followed by lactation increase the health risk of mothers resulting in a high maternal mortality (3). Lack of sufficient calories, of macro- and micronutrients by the mothers during critical times like pregnancy and lactation can lead to deficiencies in building materials for the development and growth of the new born (5).

Household food insecurity, hunger and under-nutrition remain critical issues in different developing countries including Ethiopia (6). In Ethiopia, although there are maternal nutrition interventions that are efficacious and effective in improving maternal, neonatal, and child health (MNCH) outcomes, implementations have been limited (7, 8).

Malnutrition has been identified as a key underlying cause for maternal deaths. It pre-disposes pregnant and lactating women to an increased risk of infection, anemia, visual impairment, goiter among others. Environmental and economic conditions have huge impacts on the nutritional status of women in Sub-Saharan Africa. In this population, poverty limits food choices, thus affecting their quality of diet (9).

Ethiopia has reached Millennium Development Goal (MDG) 1, halving the number of undernourished people (from 75 percent to 35 percent over two decades). Despite these positive advances, Ethiopia remains one of the world’s most food-insecure countries, where approximately one in three people live below the poverty line and about 27% of women age 15–49 were undernourished (BMI of less than 18.5 kg/m2) (10).

To solve the problem of maternal malnutrition, micronutrient supplementation and food-based strategies such as diet diversity and food fortification have been reported in many studies in Sub-Saharan Africa (9, 11). Despite these efforts, the proportion of children and mothers affected by
malnutrition is still high (2, 3, 12). In addition, few studies in Ethiopia highlighted the issue of nutritional status among lactating mothers. So, the main aim of this study was to assess undernutrition and associated factors of lactating mothers in Arba Minch zuria district, Southern Ethiopia. The findings of this study is vital for policy makers, health care providers and any concerned bodies to design appropriate intervention strategies to tackle the problem.

2. Methods And Materials
Quantitative institution based cross-sectional study was conducted on lactating women who visited Arba Minch Zuria district health centers from June 5–20/2018. All lactating mothers visited public health centers of the area were the source population and all lactating mothers visited selected public health centers of the area during data collection period were the study population. Lactating mothers who lived in the area for more than six month and visited the public health centers of the area were included into the study. Lactating mothers who were critically ill, have hearing impairment and physical deformity that can alter anthropometric measurements were excluded from the study.

2.1. Sample size determination and sampling procedures
Sample size was calculated using single population proportion formula by considering the following assumptions: \( P = 20\% \) (prevalence of underweight among lactating mothers from the study conducted in Nekemte town (2), Significance level of 5\% \((\alpha = 0.05)\), and \( Z_{\alpha/2} = 1.96 \), Margin of error of 4\% \((d = 0.04)\) and 10\% non-response rate, the final sample size becomes 441 lactating mothers.

To get the eligible respondents, first, out of the seven health centers in Arba Minch zuria district, four of them were selected by using lottery method. Then, the calculated sample size was proportionally allocated to the health centers based on their population size according to the average number of clients registered prior to the study period in the respective health center. Finally the eligible respondents were selected by using systematic sampling method.

2.2. Measurements
In this study, lactating mother is a mother who is feeding breast milk for her infant/child during the study period. Body mass index is defined as the weight in kilograms divided by the square of the height in meters \((kg/m^2)\). Under-nutrition is defined as, lactating mothers with BMI of \( \leq 18.5 \) kg/m\(^2\). Individual Dietary Diversity Score is defined as, the sum of food groups eaten in a specified reference
period.

Food secure households are those who were not experienced none of the food insecurity (access) conditions or just experienced worry, but rarely in the past 4 weeks. Food insecure households is inability of households to access sufficient food at all time to lead active and healthy life (includes all stages of food insecurity; mild, moderate and severe). Mildly food insecure households are households that worried about not having enough food sometimes or often, and/or are unable to eat preferred foods, and/or eat a more monotonous diet than desired and/or some foods considered undesirable, but only rarely. Moderately food insecure households are households sacrifices quality more frequently, by eating a monotonous diet or undesirable foods sometimes or often, and/or have started to cut back on quantity by reducing the size of meals or number of meals, rarely or sometimes. But it does not experience any of the three most severe conditions. Severely food insecure households are those household who has graduated to cutting back on meal size or number of meals often, and/or experienced any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating), even as infrequently as rarely.

2.3. Data collection procedure
Data was collected using structured interview administered questionnaire adopted from similar studies and modified based on the study variables and local context. The questionnaire first prepared in English and translated to Amharic and then translated back to English by bilingual expert, to check its Consistency. Twelve female diploma nurse data collectors and three MPH supervisors were recruited and trained for data collection.

2.4. Data Quality Assurance
To ensure the quality of data, training was given for data collectors and supervisors. Pre-test was conducted on 5% of the total sample to assess its clarity, length, completeness and consistency. The questionnaire was also translated to Amharic and close supervision was undertaken.

2.5. Data Processing and analysis
Data was coded, entered into Epi data version 3.02 and exported to SPSS version 20.0 for analysis. Descriptive statistics was computed to determine the frequency and percentages. Binary logistic regression was conducted and COR with 95% CI was estimated to select the candidate variables for
the final model. Then, variables with p-value of < 0.25 at binary logistic regression were taken into multivariable logistic regression to control confounding. Hosmer-Lemeshow goodness-of-fit with stepwise (backward elimination) logistic regression was used to test for model fitness. AOR with 95% CI was estimated to assess the presence of association at multivariable logistic regression. Finally, variables with p-value of < 0.05 were considered as statistically significant predictors of the outcome variable.

3. Results

3.1. Socio-demographic characteristics of the study respondents

Out of the total 445 sample size calculated for the study, 441 respondents responded making a response rate of 99.1%. The age of the respondents ranges from 15 to 46 with mean and standard deviation of 26.98 ± 5.67. About 211 (47.8%) respondents were in the age group of 17–25 years, 291 (66%) were protestant and 438 (99.3%) were married. About 124 (28.1%) of mothers and 159 (36.1%) of husbands were unable to read and write. Regarding their family size, 224 (50.8%) of the respondents have 4–6 family members (Table 1).

Table 1

| Variables                        | Category                  | Frequency | Percentage |
|----------------------------------|---------------------------|-----------|------------|
| Age of mothers (in year)         | 17–25                     | 211       | 47.8       |
|                                  | 26–35                     | 183       | 41.5       |
|                                  | 36–49                     | 47        | 10.7       |
| Religion                         | Orthodox                  | 150       | 34.0       |
|                                  | Protestant                | 291       | 66.0       |
| Ethnicity                        | Gamo                      | 302       | 68.5       |
|                                  | Gofa                      | 13        | 2.9        |
|                                  | Wolayita                  | 24        | 5.4        |
|                                  | Amhara                    | 13        | 2.9        |
|                                  | Others*                   | 89        | 20.2       |
| Maternal educational level       | Unable to read and write  | 124       | 28.1       |
|                                  | Able to read and write    | 92        | 20.9       |
|                                  | primary secondary and above| 136      | 30.8       |
|                                  | 89                        |           | 20.2       |
| Husband’s educational level      | Unable to read and write  | 159       | 36.1       |
|                                  | read and write primary    | 89        | 20.2       |
|                                  | secondary and above       | 102       | 23.1       |
|                                  | 91                        |           | 20.6       |
| Mother’s Occupation              | Farmer                    | 305       | 69.2       |
|                                  | Merchant                  | 72        | 16.3       |
|                                  | Government employer       | 64        | 14.5       |
| Family size                      | 1–3 members               | 121       | 27.4       |
|                                  | 4–6 members               | 224       | 50.8       |
|                                  | > 6 members               | 96        | 21.8       |

* = Oyda, Basketo, Oromo

3.2. Maternal Health Care and Feeding Practices

Among the total respondents, 228 (51.7%) were experienced one to two pregnancies. Majority of the
respondents, 198 (44.9%) spaced their children from 1–2 years and 274 (62.1%) had ≥ 4 ANC visits during their last pregnancy. Majority of lactating mothers, 276 (62.6%) were using family planning methods and out of these, 146 (33.1%) uses injectable, whereas only 4 (0.9%) uses pills. About 95 (21.5%) of respondents had experienced diarrhea in the last two weeks preceding the study period. Majority of the respondents, 310 (70.3%) has their own latrine. The mean ± SD of lactating mothers dietary diversity score was 5.0 ± 1.89 and majority of them, 296 (67.1%) had mean DDS of ≥ 5 (Table 2).

Table 2
Maternal health care and feeding practice of the study participants (n = 441) in Arba Minch zuria district, Southern Ethiopia, 2018.

| Variables                              | Category                          | Frequency | Percentage |
|----------------------------------------|-----------------------------------|-----------|------------|
| Number of pregnancy                    | 1-2                               | 228       | 51.7       |
|                                        | 3-4                               | 107       | 24.2       |
|                                        | 5-6                               | 62        | 14.1       |
|                                        | > 6                               | 44        | 10         |
| Age of breast feeding child            | Less than 6 months                | 99        | 22.4       |
|                                        | 6 to 11 months                    | 158       | 35.9       |
|                                        | 12 to 24 months                   | 184       | 41.7       |
| Space b/n index child and the previous birth | It is the first child              | 101       | 22.9       |
|                                        | 1-2 years                         | 198       | 44.9       |
|                                        | > 2 years                         | 142       | 32.2       |
| Antenatal care for the last pregnancy  | Yes                               | 413       | 93.7       |
|                                        | No                                | 28        | 6.3        |
| Number of antenatal care (n = 413)     | First ANC                         | 12        | 2.7        |
|                                        | Second ANC                        | 38        | 8.6        |
|                                        | Third ANC                         | 89        | 20.2       |
|                                        | Fourth ANC and above              | 274       | 62.1       |
| Current use of family planning         | Yes                               | 276       | 62.6       |
|                                        | No                                | 165       | 37.4       |
| Which method is used (n = 276)         | Pills                             | 4         | 0.9        |
|                                        | Dipo                              | 146       | 33.1       |
|                                        | implant                           | 109       | 24.7       |
|                                        | IUCD                              | 17        | 3.9        |
| The last time menstruation is seen     | In this month                     | 118       | 26.8       |
|                                        | Before one month                  | 131       | 29.7       |
|                                        | Don't know                        | 192       | 43.5       |
| Time to breast feed                    | < 6 month                         | 21        | 4.8        |
|                                        | 6-11 month                        | 75        | 17.0       |
|                                        | 12-24 month                       | 260       | 59.0       |
|                                        | > 24 month                        | 62        | 14.0       |
|                                        | do not know                       | 23        | 5.2        |
| Start of complementary feeding         | Yes                               | 345       | 78.2       |
|                                        | No                                | 96        | 21.8       |
| Age at start of complementary feeding  | < 6 month                         | 80        | 18.1       |
|                                        | at 6 month                        | 215       | 48.8       |
|                                        | > 6 month                         | 50        | 11.3       |
| Mothers diarrhea in the last two weeks | Yes                               | 95        | 21.5       |
|                                        | No                                | 346       | 78.5       |
| Presence of toilet                     | Yes                               | 310       | 70.3       |
|                                        | No                                | 131       | 29.7       |
| Source of drinking water               | Tap                               | 279       | 63.3       |
|                                        | Protected                         | 80        | 18.1       |
|                                        | river/not protected               | 66        | 15         |
|                                        | Hole                              | 16        | 3.6        |
| Nutrition education                    | Yes                               | 296       | 67.1       |
|                                        | No                                | 145       | 32.9       |
| Sources of nutrition education (n = 296) | Health professionals             | 251       | 56.9       |
|                                        | Mass media                        | 45        | 10.2       |
| Women dietary diversity score (WDDS)   | < 5                               | 145       | 32.9       |
|                                        | ≥ 5                               | 296       | 67.1       |
3.3. Household food security level of the study participants
Household food security of the study respondents was assessed and classified as: food secured, mildly food in secured, moderately food in secured and severely food in secured. Accordingly, majority, 377 (85.5%) of households were food secured and only 11(2.5%) of the respondents household were severely food in secured (Fig. 1).

3.4. Under nutrition among lactating mothers
The overall prevalence of under nutrition (BMI < 18.5 kg/m2) among lactating mothers in this study was 26.1% (Fig. 2).

3.5. Factors associated with under nutrition among lactating mothers
3.5.1. Binary Logistic Regression analysis
In binary logistic regression analysis, maternal education (COR [95%CI] = 4.478[2.164, 9.269]), husband education (COR[95%CI] = 4.65[2.237,9.672]), having experienced > 3 pregnancies (COR[95%CI] = 2.704[1.582, 4.623], having > 4 family size (COR[95%CI] = 2.473[1.461,4.186]), absence of toilet (COR[95%CI] = 5.121[3.242,8.089]), < 4 ANC visits for the last pregnancy (COR[95%CI] = 2.99[1.965,4.692]), presence of maternal diarrhea (COR[95%CI] = 1.824[1.120,2.970]), absence of nutritional education (COR[95%CI] = 1.870[1.205,2.902]) and being severely food insecure (COR[95%CI] = 5.176[1.483, 18.073]) shows significant association with under nutrition (Table 3).

| Variables                  | Category                                 | Under-nutrition | COR[95%CI]         | P-Value |
|----------------------------|------------------------------------------|-----------------|--------------------|---------|
| Maternal age (in years)    | 17–25                                    | 52 48 15        | 1.087[0.690,1.713] | 0.718   |
|                            | 26–35                                    | 159 32          | 1.433[0.720,2.854] | 0.306   |
|                            | 36–49                                    | 159 32          | 1.433[0.720,2.854] | 0.306   |
|                            | 52                                        | 159 32          | 1.433[0.720,2.854] | 0.306   |
| Maternal educational level | Unable to read and write                 | 48 39 17 11     | 4.478[2.164,9.269] | 0.001   |
|                            | Able to read and write                   | 76 53 119 78    | 5.218[2.453,11.097] | 0.005   |
|                            | Primary Secondary and above               | 1.103[0.450,2.278] | 0.975   |
| Husband’s educational level| Unable to read and write                 | 58 25 22 10     | 4.651[2.237,9.672] | 0.001   |
|                            | Able to read and write                   | 101 64 80 81    | 3.164[1.417,7.065] | 0.052   |
|                            | Primary Secondary and above               | 2.727[0.992,5.001] | 0.406   |
| Mather’s occupation        | Farmer                                    | 77 23           | 1.236[0.658,2.322] | 0.511   |
|                            | Merchant                                  | 217 58          | 1.236[0.658,2.322] | 0.511   |
| Source of drinking water | Tap water | Protected River/not protected Hole | 1.33[0.767,2.30] | 1.164[0.634,2.135] | 1.410[0.473,4.203] | 1.240[0.777,1.980] | 1.240[0.777,1.980] | 1.001
| Number of ANC visit | 2.99[1.965,4.69] | 1.001 | 1.001 | 1.001 | 1.001 | 1.001 | 1.001 | 1.001
| Current use of family planning | 1.104[0.713,1.708] | 1.104[0.713,1.708] | 1.104[0.713,1.708] | 1.104[0.713,1.708] | 1.104[0.713,1.708] | 1.104[0.713,1.708] | 1.104[0.713,1.708] | 1.104[0.713,1.708]
| The last time menstruation have seen | 1.060[0.589,1.906] | 1.060[0.589,1.906] | 1.060[0.589,1.906] | 1.060[0.589,1.906] | 1.060[0.589,1.906] | 1.060[0.589,1.906] | 1.060[0.589,1.906] | 1.060[0.589,1.906]
| Space between index child and the previous birth | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185]
| Time of breast feeding | 1.164[0.377,3.582] | 1.164[0.377,3.582] | 1.164[0.377,3.582] | 1.164[0.377,3.582] | 1.164[0.377,3.582] | 1.164[0.377,3.582] | 1.164[0.377,3.582] | 1.164[0.377,3.582]
| Start of CF | 1.075[0.639,1.808] | 1.075[0.639,1.808] | 1.075[0.639,1.808] | 1.075[0.639,1.808] | 1.075[0.639,1.808] | 1.075[0.639,1.808] | 1.075[0.639,1.808] | 1.075[0.639,1.808]
| Age at start of CF | 1.006[0.556,1.820] | 1.006[0.556,1.820] | 1.006[0.556,1.820] | 1.006[0.556,1.820] | 1.006[0.556,1.820] | 1.006[0.556,1.820] | 1.006[0.556,1.820] | 1.006[0.556,1.820]
| Maternal diarrheal disease | 1.824[1.120,2.970] | 1.824[1.120,2.970] | 1.824[1.120,2.970] | 1.824[1.120,2.970] | 1.824[1.120,2.970] | 1.824[1.120,2.970] | 1.824[1.120,2.970] | 1.824[1.120,2.970]
| Nutritional education | 1.545[0.713,3.350] | 1.545[0.713,3.350] | 1.545[0.713,3.350] | 1.545[0.713,3.350] | 1.545[0.713,3.350] | 1.545[0.713,3.350] | 1.545[0.713,3.350] | 1.545[0.713,3.350]
| Sources of nutritional education | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185] | 1.018[0.474,2.185]
### 3.5.2. Multivariable Logistic Regression Analysis

In multivariable logistic regression analysis, variables like maternal education, number of pregnancy, family size, presence of toilet and number of antenatal care visits shows significant association with under nutrition.

Mothers who are unable to read and write were almost four times more likely to be undernourished compared to those with secondary and above educational levels (AOR[95%CI] = 3.93 [1.700, 9.091]). Respondents who experienced 5–6 number of pregnancies were 2.45 times more likely to be undernourished compared to those who experienced 1–2 pregnancies (AOR[95%CI] = 2.453 [1.051, 5.728]). Similarly, respondents who have family size of 4–6 members were 2.3 times more likely to be under nourished compared to those who have family size of 1–3 members (AOR[95%CI] = 2.289 [1.171, 4.472]).

Respondents who live in the household with no toilet were 6.4 times more likely to be undernourished compared to their counterparts (AOR [95%CI] = 6.407 [3.556, 11.545]). Respondents who visited < 4 ANC were 2 times more likely to be under nourished compared to those who visited greater than or equal to four (AOR[95%CI] = 2.053 [1.185, 3.559]) (Table 4).
### Table 4
Multivariable logistic regression showing factors associated with under nutrition among lactating mothers in Arba Minch zuria district, Southern Ethiopia, 2018

| Variables                      | Category                                      | Under-nutrition | COR[95%CI]                       | AOR[95%CI]                       |
|--------------------------------|-----------------------------------------------|-----------------|----------------------------------|----------------------------------|
| Maternal educational level     | Unable to read and write                      | Yes             | 48                              | 5.218[2.453,11.097]              |
|                                | Able to read and write                        |                 | 53                              | 1.103[0.450,2.278]               |
|                                | Primary                                       |                 | 11                              | 1.005[0.329,3.014]               |
|                                | Secondary and above                           |                 | 78                              | 1.143[0.562,2.327]               |
| Husband’s educational level     | Unable to read and write                      | Yes             | 58                              | 4.651[2.337,9.623]               |
|                                | Able to read and write                        |                 | 25                              | 2.704[1.582,4.617]               |
|                                | Primary                                       |                 | 22                              | 3.852[2.077,7.142]               |
|                                | Secondary and above                           |                 | 10                              | 3.358[1.662,6.786]               |
| Number of pregnancy            | 1–2 pregnancies                               | Yes             | 36                              | 1.005[0.329,3.014]               |
|                                | 3–4 pregnancies                               |                 | 36                              | 1.005[0.329,3.014]               |
|                                | 5–6 pregnancies                               |                 | 26                              | 1.005[0.329,3.014]               |
|                                | > 6 pregnancies                               |                 | 17                              | 1.005[0.329,3.014]               |
| Family size                    | 1–3 members                                   | Yes             | 25                              | 2.704[1.582,4.617]               |
|                                | 4–6 members                                   |                 | 65                              | 2.473[1.461,4.186]               |
|                                | > 6 members                                   |                 | 23                              | 1.360[0.732,2.530]               |
| Presence of toilet             | Yes                                           | Yes             | 50                              | 1.521[3.242,8.089]               |
|                                | No                                            |                 | 65                              | 1.521[3.242,8.089]               |
| Number of ANC visit            | < 4 visits                                    | Yes             | 64                              | 2.99[1.965,4.692]                |
|                                | ≥visits                                       |                 | 45                              | 2.99[1.965,4.692]                |
| The last time menstruation     | In this month                                 | Yes             | 24                              | 1.214[0.665,2.218]               |
| have seen                      | Before 1 month                                |                 | 31                              | 1.780[1.035,3.062]               |
|                                | Don’t know                                    |                 | 60                              | 1.824[1.120,2.970]               |
| Maternal diarrheal disease     | Yes                                           | Yes             | 34                              | 1.824[1.120,2.970]               |
|                                | No                                            |                 | 81                              | 1.824[1.120,2.970]               |
| Nutritional education          | Yes                                           | Yes             | 65                              | 1.870[1.205,2.902]               |
|                                | No                                            |                 | 50                              | 1.870[1.205,2.902]               |
| WDD mean score                 | < 5                                           | Yes             | 46                              | 1.529[0.983,2.377]               |
|                                | ≥5                                            |                 | 69                              | 1.529[0.983,2.377]               |
| Household food security        | Food secure                                   | Yes             | 95                              | 1.109[0.422,2.916]               |
|                                | Mildly food insecure                          |                 | 6                               | 0.863[0.360,2.066]               |
|                                | Moderately food insecure                      |                 | 7                               | 5.176[1.483,18.073]              |
|                                | Severely food insecure                        |                 | 1                               | 1.143[0.562,2.327]               |
|                                | Food secure.                                  |                 | 1                               | 1.143[0.562,2.327]               |
|                                | Food insecure.                                |                 | 1                               | 1.143[0.562,2.327]               |

Keys: COR = Crude Odds ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval; WDD = Women Dietary Diversity; *=P-value < 0.05

### 4. Discussion

In this study, about 26.1% of lactating mothers were undernourished. Under nutrition was more common among mothers who are unable to read and write, those who experienced high number of pregnancies, those with high family size, those who reside in the household with no toilet, and those...
who have less than four ANC visits for their last pregnancy.

The prevalence of under nutrition in this study was comparable with findings of study conducted in Rayitu district of Ethiopia (24%) (13), Alamata, Tigiray (24.6) (14) and Womberma district of North West Ethiopia (25.4%) (15). However, the prevalence is lower than study conducted in Samre district of Tigray (31%) (3), and Dedo and Seka chekors’s of Jimma district (40.6%) (16). The difference might be as a result of improvement in nutritional education, improvement in socio-economy and difference in geographical setting. But, the finding of this study is higher than study conducted in Tanzania (11%) (17), Nigeria (5%) (18), Nekemte town (20%) (2), Ambo districts (21.5%) (19), and Offa district of Wolayta zone (15.8%) (20). The reason for this discrepancy may be due to difference in socio-economy, geographical settings, and seasonal variation.

Mothers who are unable to read and write were almost four times more likely to be under nourished compared to those who have secondary and above educational level. This finding is consistent with studies conducted in Bangladesh (21), Ambo district (19), Adama district (22), and Offa district (20). The possible reason may be since those who are able to read and write can get nutritional information through reading books, posters and magazines than those who are unable to read and write.

Respondents who experienced 5–6 pregnancies were 2.5 times more likely to be under nourished compared to those who experienced 1–2 pregnancies. The finding of this study was inconsistent with study conducted in Alamat highland of Tigray in which respondents who have higher pregnancies were 44% less likely to be undernourished compared to those who lower pregnancies (14). However, this finding is supported by study conducted in Babile, Ethiopia, which shows, as parity increased by one unit, the BMI of the lactating mothers decreased (23). The possible reason may be, because of the fact that, as the number of pregnancy increases, exposure to different health problems including under nutrition may occur. In addition, the mother herself may be biologically depleted from too frequent births, which could also negatively affect the nutritional status of herself and her newborn.

Respondents whose family size is greater than four members were 2.29 times more likely to be under nourished compared to those who have less family size. This finding is supported by the study conducted in Womberma district of North West Ethiopia (15) and Nekemte town (2). This may be due
shortages of food in the household with high family size, and culturally mothers always eat least food (some time leftover) at the last which leads to under nutrition.

Respondents who have toilet were 6.4 times more likely to be undernourished compared to their counterparts. This is supported by study conducted in Adama district (22). The reason might be due to the fact that, open defecation, because of lack of toilet results in an increased risk of diarrheal disease, which might contributes to under nutrition. In addition, poor handling and disposal of household wastes including human excreta are major causes of environmental pollution, which creates breeding grounds for pathogenic microorganism that causes under nutrition.

Respondents who visited ANC < 4 times were two times more likely to be undernourished compared to those who visited ≥ 4 times. This finding is consistent with the study conducted in Samre district of Tigray (3) and Rayitu districts of Ethiopia (13). This may be because of the fact that, ANC time is a time when nutritional information and other support for healthy behaviors is widely provided and might contribute to the lower probability of getting under nutrition.

5. Limitations
Since some question asks about past events, recall bias may occur
An anthropometric measurement error may also occur

6. Conclusions And Recommendations
6.1. Conclusions
The result of this study shows slightly high proportion of under nutrition among lactating mothers.

Predictors of under nutrition among lactating mothers in this study includes: maternal educational level, number of pregnancy, family size, presence of toilet and number of ante natal care visits.

6.2. Recommendations
Based on the finding of this study, the following recommendations were made:

**Arba Minch woreda health office:**
Should strengthen health education programs on proper maternal and child dietary practices and the need of adequate dietary intake during pregnancy and lactation in order to improve health and nutrition outcomes of lactating mothers and their children.

Since health extension workers are more close to the community, woreda health office should work with health extension workers to increase awareness of lactating mothers on how to improve their own nutritional status.

Woreda health office should have to work with different sectors like; educational and agricultural sectors to improve women educational level and then, their nutritional status.
Health Extension workers:
Health extension workers should have to closely work with the community and provide health information like; importance of adequate nutrition during lactation, importance of having few children based on their capacity, importance of having toilet and proper use of it, and importance of antenatal and post natal visits for the community.

Researchers:
Further research that uses advanced design is needed to identify more variables that determine the nutritional status of lactating mothers.

7. Abbreviations

| Abbreviation | Description                                    |
|--------------|-----------------------------------------------|
| ANC          | Antenatal Care                                |
| AOR          | Adjusted Odds Ratio                           |
| BMI          | Body Mass Index                               |
| CI           | Confidence Interval                           |
| COR          | Crude Odds Ratio                              |
| EDHS         | Ethiopian Demographic and Health Survey       |
| FAO          | Food and Agricultural Organization            |
| MDG          | Millennium Development Goal                   |
| MNCH         | Maternal, Neonatal and Child Health           |
| SNNPR        | Southern Nation and Nationalities and Peoples Region |
| USAID        | United States Agency for International Development |

8. Declarations

8.1. Ethical approval and consent to participate
Ethical clearance was obtained from Arba Minch University Research Ethic review committee to conduct the study. In addition permission was obtained from Gamo Gofa zone health Department, managers of health centers. Confidentiality was secured by informing and giving awareness to the data collectors not to record identifiers of the client and disseminate any information obtained from client.

8.2. Consent for publication
Not applicable

8.3. Availability of data and materials
The data collected for this study can be obtained from the corresponding author based on a reasonable request.

8.4. Funding

The data collection process of this study was funded by Arba Minch University for the support of data collection. The funding body only followed the process to check whether the fund allocated was used for the proposed research.

8.5. Authors’ Contribution

GK wrote the proposal, participated in data collection, analyzed the data and drafted the paper. FG and HH approved the proposal with great revisions and revised subsequent drafts of the paper. MS and MD contributed in the designing of the methodology and write-up. All authors and read and approved the final manuscript.

8.6. Conflict of Interest

The authors declare that they have no conflict of interest regarding the publication of the paper.

8.7. Acknowledgment

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Figures

![Figure 1](image)

Household food security levels among lactating mothers (n=441) in Arba Minch zuria district, Southern Ethiopia, 2018
Figure 2

Bar chart showing nutritional status of lactating mothers (n=441) in Arba Minch zuria district, Southern Ethiopia, 2018.