# Environmental Predictors of Undernutrition Among Under-5 Children at Dabat District Health Facilities, Northwest Ethiopia, 2023

Environmental Health Insights
Volume 18: 1–9

DOI: 10.1177/11786302241252735

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## ABSTRACT

**BACKGROUND:** In Ethiopia, undernutrition remains a significant public health concern throughout the year due to persistent household food insecurit. The intensifying conflict in the Dabat district, involving the Ethiopian government and the Tigray Liberation Front, has increased the threat of undernutrition among under-5 children. The cessation of humanitarian aid has worsened food insecurity, increasing the vulnerability of the children in the region. However,there was no data showing the prevalence and environmental pridictors of undernutrition in the Dabat district, northwestern Ethiopia. Therefore, the objective of this study was to determine the prevalence of undernutrition and identify environmental pridictors in this study setting.

**METHODS:** This institutional-based cross-sectional study was conducted from January to March 2023. A total of 400 under-5 children were included in this study using systematic random sampling techniques with a 100% response rate. The study included all under-5 children who visited healthcare facilities during the data collection period. However, it excluded children under-5 who had physical deformities, were critically ill, or had congenital abnormalities or known chronic diseases such as HIV/AIDS, tuberculosis, or chronic heart diseases. Binary logistic regression was used to determine environmental predictors of undernutrition, with statistical significance at a *P*-value of ⩽.05.

**RESULTS:** The overall prevalence of undernutrition was found to be 12% (95% CI: 8.72-21.5). Among those affected, 32.8% (95% CI: 21.5-39.8) were stunted, 37.9% (95% CI: 28.8-47.50) were underweight, and 29.3% (95% CI: 21.3-29.7) were wasted. The environmental predictors of undernutrition were latrine use, recent diarrhea episodes, mothers' occupation and place of residence, water treatment before consumption, water sources and storage, water extraction methods, and mothers' handwashing habits.

**CONCLUSIONS AND RECOMMENDATIONS:** The study found a higher prevalence of undernutrition among under-5 children compared to the 2019 Ethiopia Mini Demographic and Health Survey. This study recommended raising awareness about establishing private toilets, promoting water treatment, proper latrine use, and handwashing practices. Training on personal hygiene and economic support for households should also be provided. Healthcare providers should offer quality health services for under-5 children. Further research is needed to explore specific nutrient deficiencies using laboratory methods.

## PLAIN LANGUAGE SUMMARY

What is Already Known on This Topic? Undernutrition is the main cause of child mortality, physical, and mental retardation. What This Study Adds? This research aimed to determine the current prevalence and factors that contribute to malnutrition in Dabat, Northwest Ethiopia, 2023.

**KEYWORDS:** Prevalence, stunting, underweight, wasting, Ethiopia

**RECEIVED:** November 30, 2023. **ACCEPTED:** April 18, 2024.

**TYPE:** Research Article

**FUNDING:** The author(s) received no financial support for the research, authorship, and/or publication of this article.

**DECLARATION OF CONFLICTING INTERESTS:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## Introduction

Undernutrition is a medical condition resulting from inadequate food intake, insufficient intake of the right combination of nutrients, or the body's inability to properly use the food consumed. It manifests itself in 3 forms: stunting, wasting, and underweight.[1] In 2020, global statistics revealed that approximately 149 million under-5 children were stunted, while approximately 45.4 million were wasted. Moreover, approximately 38.9 million under-5 children were identified as overweight.[1-3] Undernutrition significantly increases children's susceptibility to disease and mortality. Globally, nearly 45.4 million deaths among under-5 children are associated with undernutrition, with a substantial portion occurring in developing countries.[1] According to 2015 statistics in Ethiopia, 10% of children under-5 years of age are underweight, 29% are overweight, and 44% are stunted.[4]

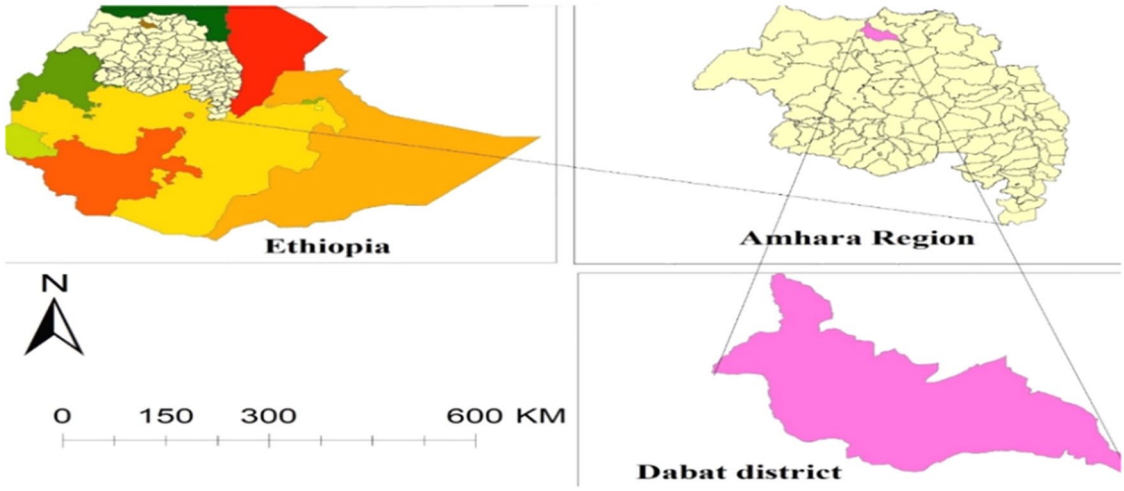


**Figure 1.** The location of the Dabat district zone in the Amhara region, Ethiopia,2023.

Undernutrition in under-5 children can lead to stunted growth, weakened immune systems, cognitive impairment, and higher mortality from illnesses like diarrhea and pneumonia. It may also result in chronic health issues later in life and perpetuate a cycle of poverty.

Addressing undernutrition is crucial to ensure healthy development and break the cycle of negative outcome.[5-8]

Several factors contribute to the occurrence of undernutrition among under-5 children. These include sociodemographic variables such as age, employment status, and educational background of parents, as well as factors such as contaminated water and sanitation, food insecurity, limited access to healthcare services, environmental pollution, inadequate housing, issues related to climate change, and a lack of education and awareness.[9-12]

People living in areas affected by conflict often struggle with issues such as food insecurity, disruptions in medical care, increased susceptibility to infectious diseases, and restricted access to humanitarian aid. These conditions increase the risk of undernutrition among under-5 children.[11-14] In Ethiopia, undernutrition remains a significant public health concern throughout the year due to persistent household food insecurity. The intensifying conflict in the Dabat district, involving the Ethiopian government and the Tigray Liberation Front, has increased the threat of undernutrition among under-5 children. The cessation of humanitarian aid has worsened food insecurity, increasing the vulnerability of the children in the region. However,there was no data showing the prevalence and environmental pridictors of undernutrition in the Dabat district, northwestern Ethiopia. Therefore, the objective of this study was to determine the prevalence of undernutrition and identify environmental pridictors in this study setting.

## Methods

### *Study design and area*

We conducted an institutional-based cross-sectional study in the Dabat district from January to March 2023. The district is located approximately 775 km from Addis Ababa and 70 km from Gondar city.In the dabat district, there are 39 rural kebeles and 4 urban kebeles, with an estimated 51 444 households and a total population of 203 050 residents. It also has 1 primary hospital, 6 health centers, and 35 health posts (Figure 1).

### *Study population*

The source population for this study consisted of all under-5 children who visited healthcare facilities in the Dabat district. The study population included all under-5 children accessing health facilities during the data collection period.

### *Eligibility criteria and inclusion criteria*

*Inclusion criteria.* All under-5 children who visited selected health facilities in the Dabat district during the data collection period.

*Exclusion criteria.* under-5 children with physical deformities, those who were critically ill, and those with congenital abnormalities or known chronic diseases such as HIV/AIDS, tuberculosis, or chronic heart disease were excluded from the study.

### *Sample size and sampling technique*

The sample size was determined using the single population proportion from the Ethiopia Demographic and Health Survey (EDHS) 2016 report on the Amhara Region, which reported a prevalence of 46%.[13]

$$ni = \frac{(Z\alpha/2)^2 * p(1-p)}{d^2} = \frac{(1.96)^2 * 0.46(1-0.46)}{(0.05)^2} = 381,$$

With a 5% contingency rate, the final sample size was Nf = 19 + 381 = 400, where ni = the initial sample size $z\alpha/2 = 1.96$ (the critical value for a normal distribution at a 95% confidence level). $P = .46$ (the proportion of stunting). $d = 0.05$ (the level of precision or acceptable error). Nf = final sample size

variables; $P = .46$ (the proportion of stunting); $d = 0.05$ (the level of precision or acceptable error); Nf = final sample size.

### *Variables*

*Dependent variable.* Undernutrition (Yes/No).

The independent variables included sociodemographic factors (age of the child, sex, number of children under 5 in the household, mother's educational status, residence, income, occupation) and environmental factors (water treatment practices, source of drinking water, ownership of latrine facilities, handwashing practices after toilet use, occurrence of diarrheal disease).

### *Operational definition*

*Malnutrition.* It refers to an imbalance between nutrient requirements and intake, which can adversely impact growth, development, and other relevant outcomes.[14]

*Undernutrition.* It was defined as under-5 children with either a z score for weight-for-height (WHZ) ⩽ −2SD or weight-for-age (WAZ) ⩽ −2SD, or a height-for-age (HAZ) ⩽ −2SD.[15]

*Stunting.* The HAZ score was considered ⩽ (SD).[15]

*Wasting.* It was defined as a WHZ score of ⩽−2SD.

**Underweight** was defined as a study participant with a weight-for-age *z* score (WAZ) ⩽−2 standard deviations (SDs).[15]

*Mid-upper arm circumference (MUAC).* We used the MUAC cut-off points of any child with a MUAC of 126 mm who was declared undernourished to evaluate whether a child was under- or overnourished.[15]

*Data collection tools.* Primarily, the questionnaire was organized in the English language by reviewing related literature and translated into the Amharic language to facilitate the communication between the data collector and study participants. The tool included data on sociodemographic characteristics and clinical and environmental factors. All measurements were conducted using a standardized protocol with calibrated equipment adhering to international standards for anthropometric measurements. Weight measurements for children aged 2 years and younger were taken using a baby scale, with the children wearing light clothing. Moreover, their height was measured horizontally using a wooden UNICEF height sheet. For children older than 2 years, weight was assessed while they stood on the center of a scale, wearing lightweight clothing, and without shoes. To measure a child's height, they were required to stand upright on a wooden height measuring board facing forward with their head held high. Subsequently, the anthropometric data were entered into the WHO Antero Plus software version 3.2.2 for analysis.[16] After receiving the necessary training, 2 female clinical nurses and 2 female midwifery professionals collected all of this data. Prior to data collection, the tool's validity and reliability were assessed, and the Cronbach's alpha was .757.

### *Statistical analysis*

The data were entered and cleaned using EpiInfo version 7, while analysis was conducted using SPSS V.26 software. Descriptive analysis was used to generate frequencies, percentages, mean, and standard deviations for the study variables. The chi-squared test was employed to assess associations between dependent and independent variables. Next, bivariable and multivariable binary logistic regression analyses were performed. In the bivariable analysis, predictor variables with a *P*-value < .2 were selected for multivariable analyses. Subsequently, in multivariable logistic regression, variables with $P \leqslant .05$ were identified as environmental predictor variables of undernutrition. The hosmer lemeshow test was used to assess the fitness of the final model.

### *Ethical considerations*

Ethical approval was obtained from the Institutional Review Board of the University of Gondar (IRB/346/2023). According to the Helsinki Declaration, under-5 children are incapable of providing informed consent on their own.[17] Thus, their mothers or other caregivers provided their informed consent.

## Results

### *Background characteristics of the study subjects*

In this study, a total of 400 under-5 children were included, 227 of whom (56.8%) were female. The mean age of the under-5 children was 30.68 (±3.49 SD) months. Approximately 37% of mothers had a diploma or above educational backround. Of the participants included in this study, 62% came from rural areas (Table 1).

### *Environmental health characteristics*

The findings indicate that the majority of study participants (83.7%) reported consuming treated water and having continuous access to it. Among the 400 households, 92 (23.0%) engaged in open defecation. Additionally, one-fifth of the study participants reported never washing their hands after using the toilet (refer to Table 2 for details).

### *Prevalence of undernutiion*

The study found that the overall prevalence of undernutrition was 12% (95% CI: 8.72-21.5). Among the undernourished patients, 32.8% (95% CI: 21.5-39.8) were stunted based on their height-for-age *z*-score (HAZ). Additionally, 37.9% (95% CI: 28.8-47.5) were classified as underweight according to their weight-for-age *z*-score (WAZ), and 29.3% (95% CI:

**Table 1.** Background characteristics of the study participants in the Dabat district, Northwest Ethiopia, 2023.

| VARIABLES | CATEGORIES | FREQUENCY | (%) |
|---|---|---|---|
| Age of the child in month | <30 | 173 | 43.3 |
| | 31-45 | 132 | 33.0 |
| | ⩾46 | 95 | 23.8 |
| | Mean age = 30.68 ± 3.491(Std. Dev) | | |
| Sex | Male | 173 | 43.3 |
| | Female | 227 | 56.8 |
| No. of the under-5 y of age | 1 | 350 | 87.5 |
| | ⩾2 | 50 | 12.5 |
| Residence | Rural | 152 | 38.0 |
| | Urban | 248 | 62.0 |
| Mothers educational status | Not read and write | 115 | 28.7 |
| | Read and write | 46 | 1.5 |
| | Primary education | 14 | 3.5 |
| | Secondary education | 77 | 19.3 |
| | Diploma and above | 146 | 6.5 |
| Vaccination status | Partial vaccinated | 37 | 9.2 |
| | Fully vaccinated | 363 | 90.8 |
| Mothers occupation | Housewife | 144 | 36.0 |
| | Government employee | 204 | 51.0 |
| | Private | 52 | 13.0 |

**Table 2.** Environmental characteristics of the study participants in the Dabat district, Northwest Ethiopia, 2023.

| VARIABLES | CATEGORIES | FREQUENCY | PERCENT |
|---|---|---|---|
| Latrine ownership | Not at all | 92 | 23.0 |
| | Commune latrine | 53 | 13.3 |
| | Private latrine | 255 | 63.7 |
| Major water source | Pipe | 245 | 61.3 |
| | Protected well or spring | 81 | 20.3 |
| | Unprotected well or spring | 63 | 15.8 |
| | River | 11 | 2.8 |
| Does the water available at all time | Yes | 75 | 18.8 |
| | No | 322 | 80.5 |
| Time to fetch water | <30 min | 131 | 32.8 |
| | ⩾30 min | 269 | 67.2 |
| Household water treatment | Yes | 65 | 16.3 |
| | No | 335 | 83.7 |
| Do you cover drinking water storage always? | Yes | 332 | 83.0 |
| | No | 68 | 17.0 |
| How do you take water from the drinking water storage container? | Pouring | 303 | 75.8 |
| | Dipping | 97 | 24.2 |
| Do you wash fruits or vegetables before consumption? | Rarely | 77 | 19.3 |
| | Sometimes | 49 | 12.3 |
| | Always | 274 | 68.5 |
| Do you trim a child's nails when grown | Rarely | 49 | 12.2 |
| | Sometimes | 65 | 16.3 |
| | Always | 286 | 71.5 |
| Mothers/ caregivers hand washing after toilet | Never | 81 | 20.3 |
| | Sometimes | 70 | 17.4 |
| | Always | 249 | 62.3 |

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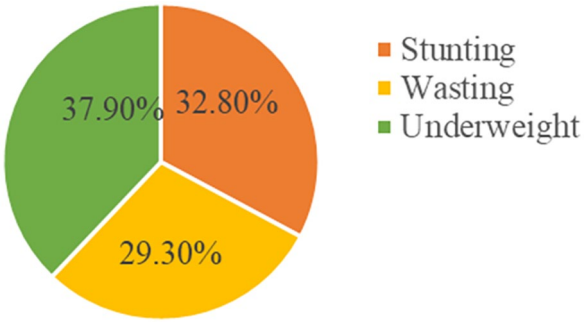


**Figure 2.** Undernutrition status of 5-children in Dabat district, Northwest Ethiopia, 2023.

21.3-29.7) were wasted based on their weight-for-height z-score (WHZ) (refer to Figure 2).

### *Factors associated with undernutrition*

Multivariable logistic regression analysis showed that undernutrition was significantly associated with latrine utilization, diarrhea within 2 weeks, mothers' occupation, residence, drinking untreated water, latrine ownership, water sources, water storage status, ways of taking water from storage, and mothers' hand washing after toilet. The odds of stunting were

higher among under-5 children whose parents reported improper latrine use compared to those whose families reported proper latrine use (AOR = 9.76; 95% CI: 3.29-15.71). The odds of becoming stunted, wasted, and underweight were higher among the children affected by diarrhea (AOR = 11.67; 95% CI: 4.86-28.07), (AOR = 9.16; 95% CI: 3.92-21.39), and (AOR = 8.57, 95% CI: 4.09-17.93), respectively. Compared to mothers who were government employees, housewife mothers had a higher likelihood of their children experiencing wasting (AOR = 5.53, 95% CI: 42.03-15.05) and being underweight (AOR = 3.58, 95% CI: 1.27-10.06). Under-5 children in rural areas had higher odds of stunting (AOR = 8.51; 95% CI: 3.35-22.16), wasting (AOR = 2.98; 95% CI: 1.44-3.76), and being underweight (AOR = 6.07; 95% CI: 2.88-12.80). Under-5 children from households with improper drinking water storage had higher odds of stunting (AOR = 2.83; 95% CI: 3.99-14.57) and wasting (AOR = 3.81; 95% CI: 3.99-14.57) compared to those from households that stored their drinking water properly. Under-5 children whose mothers never or occasionally washed their hands after using the toilet had significantly higher odds of wasting compared to those whose mothers always washed their hands (AOR = 2.20, 95% CI: 1.91-5.53). Similarly, children whose mothers never or sometimes washed their hands after using the toilet had higher odds of being underweight compared to those whose mothers always washed their hands, with adjusted odds ratios of 2.51 (95% CI: 2.21-8.83) and 1.51 (95% CI: 1.12-4.34), respectively (Table 3).

## Discussion

The study findings showed that undernutrition was more prevalent among children under-5 (refer to Figure 1). This aligns with a study conducted in Debre Birhan, Ethiopia, 15.8%.[18] However, our reported results is higher than those reported in a study conducted in South Africa, 3.8%[19] and lower than in a study conducted in Dera district, northwest Ethiopia, 69.8%.[20]

The differences observed in the results could be attributed to variations in sample size, study design, and a range of cultural, environmental, and social factors, including dietary habits.[21] The prevalence of stunting was higher among children under-5 (as shown in Figure 1), which is consistent with findings from Dessie town, northeast Ethiopia, where the prevalence was 36.8%,[22] in Lesotho, 33.3%,[23] in Botswana, 38.7%,[24] in India, 35.5%,[25] and in Nepal, 36%.[26] However, this result was higher than that reported in China, 4.4%.[27] This could be attributed to China being one of the most developed countries globally, leading to better nutritional behaviors compared to Ethiopia.[28] Another possible explanation for this difference may be due to economic disparities. Households with limited income often struggle with inadequate financial resources, leading to inconsistent access to sufficient food to maintain an active and healthy lifestyle. This situation often leads to inconsistent eating patterns and a dependence on inexpensive, calorie-dense foods that lack vital nutrients. As a result, this can cause undernutrition in the long run.[29] In this study, the prevalence of underweight among under-5 children was significantly high (see Figure 1), which is similar to the prevalence of underweight reported in studies in Tanzania 46.0%,[30] India, 36%,[31] and Bangladesh, 32.8%.[32]

However, the present outcome exceeds that of a study conducted in China (3.9%)[33] and earlier studies in Ethiopia (27.6%).[22] The possible explanation for the variation in the prevalence of underweight could be differences in economic development and child feeding status.[28]

In this study, the prevalence of wasting was higher among under-5 children, as shown in Figure 1. This finding is consistent with previous research conducted in Ethiopia, where the prevalence rates were reported to be 7.3% and 11.5%[22,34]; India, 10.5%[35]; Tanzania, 24.7%[30]; and China, 4.0%.[33] However, the current prevalence of wasting was lower than the 28.5% reported in other studies conducted in India.[31] The discrepancy in the prevalence of underweight, stunting, and wasting across studies could be due to feeding-related cultural practices rendered to children in complementary and deterring nourishing practices.[36,37] Moreover, in the last 2 years, Ethiopia has undergone significant political liberalization alongside a notable increase in violent conflicts. This surge in violence has resulted in the displacement of the Amhara community, leading to increased poverty and undernutrition among the Amhara people, particularly affecting children.[38]

In the final model, the analysis showed a significant association between undernutrition and several factors, such as latrine use, recent episodes of diarrhea, mothers' occupation and place of residence, water treatment practices before consumption, latrine ownership, sources of water, water storage conditions, methods of extracting water from storage, and mothers' handwashing habits after toilet use (see Table 3). Children of mothers with no formal education were more likely to be underweight, wasted, and stunted than children of educated mothers were. This result is supported by earlier research conducted globally.[30,39-42]

The observed difference may result from educated mothers having the skills to care for their children effectively and higher incomes to support their families. Overall, education equips mothers with the knowledge, skills, and resources necessary to ensure their children receive proper nutrition and healthcare, reducing the risk of undernutrition.[43-45]

The prevalence of underweight and wasting among under-children was higher among housewife mothers compared to those employed by the government. This result is consistent with earlier research.[46,47] One possible reason for this difference is that mothers who are economically empowered in their careers can use their income to provide their children with nutritious food and access quality medical care to prevent illness.[48,49] Another factor linked to underweight, wasting, and stunting in under-5 children was the source of water.

**Table 3.** Bivariable and multivariable logistic regression analysis of undernutrition with predictor variables among under-5 children in the Dabat district, Northwest Ethiopia, 2023.

| PREDICTOR VARIABLES | OUTCOME VARIABLES | | | | | |
|---|---|---|---|---|---|---|
| | STUNTING | | WASTING | | UNDERWEIGHT | |
| | COR (95% CI) | AOR (95% CI) | COR (95% CI) | AOR (95% CI) | COR (95% CI) | AOR (95% CI) |
| Proper latrine utilization | | | | | | |
| No | 13.04 (7.664-22.22) | 9.76 (3.29-15.71)* | 13.04 (7.63-22.21) | 0.80 (0.24-2.66) | 2.93 (1.85-4.65) | 0.78 (0.32-1.99) |
| Yes | 1 | 1 | 1 | 1 | 1 | |
| Age of under-5 in a month | | | | | | |
| <24 | 17.83 (0.98-26.76 | | | | 2.19 (1.27-3.79) | 3.10 (1.60-5.98) |
| 24-36 | 35 (0.98-47.98) | | | | 0.63 (0.86-1.58) | 0.89 (0.49-1.83) |
| ⩾37 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mothers educational status | | | | | | |
| Illiterate | 47.67 (0.96-66.47) | | 22.48 (12.20-47.67) | 0.59 (0.12-2.71) | 3.10 (1.84-5.25) | 0.62 (0.22-1.78) |
| Read and write | 37.44 (0.45-53.19) | | 10.49 (2.25-38.85) | 0.90 (0.22-3.70) | 1.20 (0.57-2.53) | 1.28 (0.32-5.02) |
| Primary education | 23.77 (0.67-44.69) | | 10.12 (4.96-21.95) | 1.65 (0.16-16.94) | 1.70 (0.53-5.39) | 1.04 (0.48-2.26) |
| Secondary education | 18.22 (0.67-37.44) | | 7.84 (3.97-33.57) | 0.94 (0.26-3.08) | 1.00 (0.53-1.99) | 0.47 (0.13-1.70) |
| Diploma and above (R) | 1 | 1 | 1 | 1 | 1 | |
| Mother's occupation | | | | | | |
| Housewife | 20.74 (10.40-41.36) | 4.62 (1.78-16.66) | 15.73 (10.39-21.35) | 5.53 (2.03-15.05)** | 4.65 (2.11-10.23) | 3.58 (1.27-10.06)* |
| Private work | 3.55 (1.76-7.19) | 1.67 (0.46-5.59) | 4.55 (1.76-7.19) | 1.88 (0.64-5.49) | 1.64 (0.76-3.58) | 3.42 (1.22-9.53)* |
| Government employee (R) | 1 | 1 | 1 | 1 | 1 | 1 |
| Residence | | | | | | |
| Rural | 9.84 (5.80-16.67) | 2.98 (1.44-3.76)* | 9.84 (5.80-16.67) | 8.51 (3.35-22.16)* | 3.26 (2.11-5.04) | 6.07 (2.88-12.80)* |
| Urban (R) | 1 | 1 | 1 | 1 | 1 | 1 |
| Drinking water treatment before consumption | | | | | | |
| No | 3.67 (2.93-14.44) | 4.65 (1.18-18.32)** | 7.02 (3.97-12.42) | 3.70 (1.03-13.49)* | 2.85 (1.68-4.90) | 1.03 (0.47-2.30) |
| Yes (R) | 1 | 1 | 1 | 1 | | 1 |

*(Continued)*

**Table 3.** (Continued)

| PREDICTOR VARIABLES | OUTCOME VARIABLES | | | | | |
|---|---|---|---|---|---|---|
| | STUNTING | | WASTING | | UNDERWEIGHT | |
| | COR (95% CI) | AOR (95% CI) | COR (95% CI) | AOR (95% CI) | COR (95% CI) | AOR (95% CI) |
| Latrine ownership | | | | | | |
| No latrine at all | 5.42 (1.02-29.35) | 4.37 (2.12-6.57)* | 6.75 (4.95-12.98) | 6.05 (1.19-30.78)** | 4.06 (2.47-6.69) | 0.90 (0.31-2.56) |
| Common latrine | 1.91 (0.47-7.74) | 2.28 (0.66-7.91) | 3.39 (2.70-4.03)* | 1.94 (0.52-7.29) | 1.18 (0.68-2.28) | 0.70 (0.31-1.54) |
| Private latrine (R) | 1 | 1 | 1 | 1 | 1 | |
| Water sources | | | | | | |
| Pipe (R) | 1 | 1 | 1 | 1 | 1 | 1 |
| Protected well or spring | 7.05 (3.25-19.33) | 6.40 (2.43-17.53)** | 0.29 (0.15-0.57) | 0.47 (0.13-1.73) | 2.20 (1.29-3.77) | 1.94 (1.07-3.75)* |
| Unprotected well or spring | 9.32 (5.18-47.70) | 9.22 (5.00-12.27)** | 0.05 (0.02-0.07) | 1.01 (0.22-4.50) | 3.95 (2.22-7.05) | 1.67 (0.53-5.31) |
| River | 6.07 (5.46-15.59) | 12.52 (5.48-17.08)** | 1.27 (0.52-6.026) | 1.04 (0.54-3.74) | 17.75 (4.23-49.38) | 5.06 (1.57-25.50)* |
| Proper water storage | | | | | | |
| No | 23.55 (11.95-46.39) | 2.83 (1.07-3.12)* | 23.55 (11.95-46.39) | 3.81 (3.99-14.57)* | 3.44 (2.00-5.97) | 0.915 (0.33-2.50) |
| Yes (R) | 1 | 1 | 1 | 1 | 1 | |
| Ways of taking water from storage | | | | | | |
| Dipping | 17.04 (9.67-30.02) | 0.44 (0.15-1.25) | 17.04 (9.67-30.01) | 2.49 (1.92-6.71)* | 4.02 (2.46-6.56) | 1.85 (0.88-3.93) |
| Pouring | 1 | 1 | 1 | 1 | 1 | 1 |
| Trimming child fingernails | | | | | | |
| Rarely | 14.08 (6.94-228.56) | 0.66 (0.19-2.29) | 14.08 (6.94-28.56) | 0.69 (0.20-2.34) | 3.05 (1.64-5.66) | 1.18 (0.49-2.84) |
| Sometimes | 6.704 (2.92-15.36) | 1.80 (0.62-5.18) | 6.70 (2.92-15.36) | 1.69 (0.60-4.71) | 0.81 (0.44-1.48) | 0.58 (0.28-1.23) |
| Always | 1 | 1 | 1 | 1 | 1 | 1 |
| Mothers hand washing after toilet | | | | | | |
| Never | 1.59 (0.81-3.12) | 2.65 (0.76-7.83) | 3.80 (1.73-8.32) | 2.20 (1.91-5.53)* | 2.92 (1.73-4.92) | 2.51 (2.21-8.83)* |
| Sometimes | 0.60 (0.30-1.18) | 0.30 (0.22-3.45) | 10.24 (5.77-18.18) | 3.41 (1.53-9.34)* | 2.02 (1.06-3.87) | 1.51 (1.12-4.34)* |
| Always | 1 | 1 | 1 | 1 | 1 | 1 |

Abbreviation: R, Reference.
Hosmer and Lemeshow test for stunting = 0.743.
Hosmer and Lemeshow test for wasting = 0.632.
Hosmer and Lemeshow test for wasting = 0.347.
*$P < .05$. **$P < .01$.

Participants who used water from a river, open well, or spring had higher prevalence of stunting, underweight, and wasting in comparison to those who used tap water. This finding is consistent with previous studies.[50,51] Similarly, improper water storage or consumption of untreated water increased the risk of stunting, wasting, and underweight among under-5 children. This outcome aligns with findings from earlier studies conducted in Chad and Pakistan.[52-55] This is likely due to the link between undernutrition and frequent diarrhea and intestinal infections, often caused by poor hygiene practices and limited access to clean water.[56,57] Under-5 children whose mothers rarely or never washed their hands after using the toilet had higher rates of wasting and underweight compared to those whose mothers consistently washed their hands. This finding is consistent with previous research.[58] Frequent handwashing reduces the spread of microorganisms in food and water, lowering the risk of children contracting infections and improving the overall health of under-5 children.[59]

Those who used shared latrines or practiced open defecation had a higher risk of stunting, underweight, and wasting compared to individuals with private latrines, aligning with previous research findings.[60,61] The inconsistency may stem from open defecation's impact on soil and water, harming health, especially among under-5 children in developing countries, through various pathways.[42]

Another key predictor of undernutrition was recent diarrhea. Under-5 children who had diarrhea were more likely to experience stunting, wasting, and underweight compared to those without diarrhea. This aligns with previous research.[62,63] This could be due to diarrhea, which can lead to nutrient deficiencies and electrolyte loss, causing stunting, wasting, and underweight in under-5 children.[64] Children in rural areas were at a higher risk of stunting, wasting, and underweight compared to those in urban areas.[65] One possible reason for this difference is that children in urban areas often come from educated households and have better access to medical care and resources that support a healthy lifestyle.[66]

## Limitations of the Study

Demonstrating a cause-and-effect relationship was not feasible due to the cross-sectional study design. Furthermore, an additional limitation of this research was the impact of postwar events on the data collection process.

## Conclusion and Recommendation

The study found a higher prevalence of undernutrition among under-5 children compared to the 2019 Ethiopia Mini Demographic and Health Survey. This study recommended raising awareness about establishing private toilets, promoting water treatment, proper latrine use, and handwashing practices. Training on personal hygiene and economic support for households should also be provided. Healthcare providers should offer quality health services for under-5 children. Further research is needed to explore specific nutrient deficiencies using laboratory methods.

## Author Contributions

All the authors contributed equally.

## Data Availability

The data available from the primary authors.

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