# Prevalence of Stunting and Associated Factors among Adolescent Girls at Rural District, Eastern Zone in the War-torn Tigray Region, Ethiopia, 2024: A Community-Based Cross-Sectional Study

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**Abstract:** *Background:* Nutritional status during the adolescent period has a vital impact on lifetime nutritional status, and it is a period of vulnerability to undernutrition. Stunting is one form of undernutrition and a serious public health concern in Ethiopia. Additionally, the catastrophic war in the Tigray region, Northern Ethiopia, has an impact on the nutrition and health of the people. Despite this, there is limited evidence on the prevalence of stunting among female adolescents and associated factors generally in the region and specifically in the study area. Therefore, this study aimed to assess the prevalence and associated factors of stunting among adolescent girls at Subhasaesie District, Eastern Zone of Tigray, Ethiopia, 2024.

*Methods:* A community-based cross-sectional study design was conducted among 568 adolescent girls from July 2024 to August 2024. WHO AnthroPlus was used to calculate height-for-age. Data were entered into Epi-Data version 4.6 and analyzed in SPSS version 25. Bivariate and multivariable logistic regressions were used to identify possible predictors of stunting. OR and 95% CI were used to measure the strength of associations at a p-value of <0.05. Finally, a statement, a table, and a chart were used to present the results.

*Result:* The prevalence of stunting among adolescent girls was 39.6% (95% CI: 36.1– 43.8). Food insecurity (AOR=8.5, 95% CI: 4.32, 16.83), inadequate dietary diversity (AOR=2.17 (1.17, 4.06), late adolescence (AOR=3.05 (1.81, 5.15)), and family size >5 (AOR=2.37, 95% CI: 1.38, 4.02) were associated with higher odds of adolescent girls stunting.

*Conclusion:* The prevalence of stunting among adolescents was found to be high, exceeding the World Health Organization's adolescent nutritional targets. Food insecurity, inadequate dietary diversity, late adolescence, and family size >5 were associated with stunting. Therefore, governmental and non-governmental stakeholders should pay attention to adolescent girls' nutritional interventions and specifically address the identified factors.

**Keywords:** Prevalence, Associated factors, Stunting, Adolescent girls, rural district, Tigray.

## BACKGROUND

Adolescence is the period of life from 10 to 19 years [1, 2]. About 1.3 billion (16%) of the world's population are adolescents, and the vast majority live in low- and middle-income countries, where the adolescent population is projected to continue to grow [2]. It is a period of high nutritional needs for physical, mental, and emotional development that shapes future health and well-being, and allows one to distinguish between different nutritional facts [2-5].

Under-nutrition indicates inadequate provision of energy and nutrients and an inability to meet the body's demands for growth, maintenance, and physiological functions [1, 6]. Stunting is defined as a height-for-age *Z*-score of less than -2 standard deviations and reflects chronic undernutrition. Stunting is closely associated with poor sanitation, poor nutrient intake, and infection [7, 8].

Malnutrition in one or more forms affects every nation worldwide, and preventing it is one of the biggest global health challenges [9]. Women, infants, children, and adolescents are especially vulnerable to malnutrition [9]. The causes are inadequate dietary intake and disease, food insecurity, inadequate care for women and children, insufficient health services, and

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unsanitary environments [7]. The prevalence of stunting among adolescents worldwide is 29.1%, with higher rates in Southeast Asia and sub-Saharan Africa, and in Ethiopia is 20.7%. Ethiopia is the second most populous country in Africa, and adolescents account for 33.8% of the entire population, with a high burden of household food insecurity that directly contributes to adolescent stunting [10, 11].

Children and adolescents in the middle- and low-income countries face the triple burden of malnutrition, which makes them vulnerable to disease and early death [10, 11]. Globally, 1.49 million adolescents died in 2019, and 32.1% of the deaths were owing to undernutrition and infectious diseases [12]. Stunting among adolescents affects more than one-sixth of the world population and continues to be a primary cause of disease susceptibility, morbidity, and mortality among adolescents [6, 13, 14]. Stunting often results in delayed mental development, poor school performance, and reduced intellectual capacity, which in turn affect future economic productivity as well as obstetric complications [6, 15, 16]. Nutritious diets also allow children and adolescents to experience catch-up growth after stunting in early childhood [17, 18].

A systems approach to adolescent, maternal, and child nutrition aims to ensure the five key systems (food, health, water and sanitation, education, and social protection) for improving the nutrition of children, adolescents, and women [3]. In most developing countries, including Ethiopia, nutrition initiatives like the first 1000 days have focused on children and pregnant mothers as part of the solution to halt the intergenerational effects of malnutrition. However, this is too late to break the intergenerational cycle of malnutrition [19, 20].

Despite various interventions implemented in Ethiopia, undernutrition, especially stunting, remains a burden [21]. And also, the factors are diverse, varying in place and time. Additionally, after the devastating war that broke out in the Tigray region of Northern Ethiopia in November 2020, more than 75% of the health facilities were nonfunctional due to their destruction and looting [22, 23]. Moreover, the region experienced a devastating two-year armed conflict, which resulted in widespread disruption of livelihoods, destruction of health infrastructure, and a severe humanitarian crisis, all of which are critical determinants of nutritional status [23, 24]. Furthermore, very little is known about adolescents' nutritional status in the study area. Therefore, this study is designed to assess the prevalence and associated factors of stunting among adolescent girls.

## MATERIALS AND METHODS

### Study Design, Setting, and Population

A community-based cross-sectional study design was conducted at Subha Saesie district, Eastern Tigray, Northern Ethiopia, from July 2024 to August 2024. Subhasaesie district is found in the Eastern Zone of Tigray. It is located 908 km from Addis Ababa, the capital city of Ethiopia. Its average altitude is about 2250 meters (1800–2700 meters) above sea level. The district is bounded by the East Afar region and Ganta Afeshum to the west, Tsaedaemba district to the south, and Irob and Gulomekeda to the north. The district's climate is highland, with an annual rainfall of 500 mm. It has 13 sub-districts with a total surface area of about 1,491 square meters [District Health Office (DHO) report]. It has 6 elementary schools, 2 high schools, and 1 preparatory school, as well as 3 health centers and 13 health posts. The main source of income in the district is agriculture. The total population is 74060 (35402 males and 38658 females). Among these, 22,218 are adolescents, of which 11,842 are female [WOHO report]. All adolescent girls aged 10–19 years living in the district were included in the study. Adolescent girls and critically ill or pregnant/lactating women were excluded from the study.

### Sample Size Determination and Sampling Technique

The sample size was tried to be determined using the single population proportion formula by the first objective point (P=33.2%), which yields 341 [21]. Moreover, this study used a double population proportion formula, with factors associated with stunting, using the open Epi Info online software program, under the following assumptions: confidence level 95%, power 80%, the ratio of unexposed to exposed is 1, non-response rate 10%, and a designed effect of 1.5. Stunting among adolescent girls with literate fathers is 10.33%, and among those with illiterate fathers, it is 23.1% [25]. Hence, the final sample size was 570 (Table **1**).

A multistage systematic sampling technique was used. In the first stage, six sub-districts were selected from the district's 13 sub-districts by lottery. Based on the size of adolescent girls' populations, the sample was distributed proportionally across sub-districts. In

**Table 1: Sample Size Determination for the Factors Associated with Stunting among Adolescent Girls in Subhasaesie District, Eastern Zone of Tigray Region, Ethiopia, 2024**

| Factors considered | Proportion value (percent of exposed with outcome and percent of unexposed with outcome) | Sample Size | Reference |
|---|---|---|---|
| Mother occupation | Stunting among adolescent girls having employed mother =16.5% and with un employed mother =39.6% | 134 | [26] |
| Frequency of food intake per day | Stunting among adolescent girls of eating (<2 time per day) =48% and eating (≥ 2 times) =13.6% | 66 | [19] |
| Father educational status | Stunting among adolescent girls having a literate father=10.33% and those with an illiterate father=23.1% | 292 | [25] |

the second stage, study participants (households with at least one adolescent girl) were selected using a systematic sampling technique by preparing a sampling interval (N/n=10, where N=number of adolescent girls) using the sampling frame obtained from the health post registration book, which is the list of households with adolescent girls in each sub-district. The starting point participant was selected by lottery, and every 10th household was interviewed. If more than one adolescent girl was found in the same household, one was selected at random using a lottery.

### Study Variables

The dependent variable of this study was adolescent stunting.

The independent variables affecting this outcome were religion, occupation of the father, occupation of the mother, availability of a home garden, educational status of the mother, educational status of the father, family size (>5 or 5), dietary diversity (adequate/inadequate), frequency of meals per day, skipping regular meals, food security (secure or insecure), hand washing with soap, availability of a functional latrine, source of drinking water, nutrition information, fasting at time of data collection, cigarette smoking, menstruation (started/not), and illness in 2 weeks.

### Operational Definition

Anthropometry: The technique that deals with the measurements of the size, weight, and Proportions of the human body [17]. Stunting is defined as height-for-age below -2 Z-score of the 2007 WHO standard reference values [27].

Moderate stunting is defined as height-for-age between -3 and -2 SDs of the 2007 WHO standard reference values [27].

Severely stunted is defined as adolescents whose height-for-age Z-score is below 3 (-3.0) standard deviations (SD) below the mean on the 2007 WHO Growth Standards [27].

Poor dietary diversity is defined as when adolescent girls consume (<5 food groups from the ten food items in the previous 24 hours [28].

Good dietary diversity is defined as when an adolescent girl who consumed (≥ 5 food groups) from the ten food items in the previous 24 hours is considered [28].

Food security: Based on the Household Food Insecurity Access Scale (HFIAS) score (0– 27) of 0–1 is categorized as food secure [29].

Food insecurity: Based on (HFIAS) score (0–27) of 2 and above is considered as food insecure [29].

### Data collection Procedures and Quality Control

Data were collected using a structured interviewer-administered questionnaire and anthropometric measurements. The questionnaire was initially prepared in English first and translated to Amharic and then retranslated to English to check for its consistency. The questionnaire consists of socio-demographic and economic factors, food/dietary intake patterns, and information on other associated factors, all extracted from various literature sources [20, 28, 30, 31]. Degree-holder nurses who are fluent speakers of the local language were recruited for data collection by considering their prior experience of participation in anthropometric data collection, and degree-holding health officers have supervised the data collection process. Training was given for data collectors and supervisors. Height was measured using a portable stadiometer. The participants were measured for height by removing shoes, standing upright/straight with the head held erect, buttocks, shoulders, the back of the

head, and heels touching the scale, with knees and arms hanging naturally by the sides, and by standing on the foot mark. The questionnaire was pretested, and unclear questions were revised accordingly to ensure data quality. The collected data were reviewed and checked for completeness before data entry.

### Data Analysis

Data were checked for completeness after collection. It was entered into EpiData version 4.6 and exported to SPSS version 27 for analysis. The WHO Anthroplus computer program software was used, and the anthropometric measurement was also converted into height-for-age z scores to identify stunted adolescents. Bivariate and multivariable logistic regression analyses were performed to assess the association between different explanatory variables and stunted adolescent girls. We used descriptive statistics and bivariate statistics for analysis. Categorical variables were reported in percentages and compared using Chi-square tests. Continuous variables were presented as mean ± standard deviation (SD) for normally distributed data. Model fitness was assessed using the Hosmer-Leme show goodness-of-fit test (p-value = 0.13). The strength of association between each independent variable and the outcome variable was estimated using odds ratios with 95% confidence intervals. The level of statistical significance was reported at p-value<0.05.

## RESULTS

### Socio-Economic and Demographic Characteristics

A total of 568 participants were enrolled in the study, making a response rate of 99.6%. The mean standard deviation (±SD) age of the respondent was 44.09 (±13.04) years. Among the adolescents who participated, 319 (56.2%) were aged 10-14 years, and 265 (46.6%) were from large families (> 5 members). The occupational status of the study participants' family showed that 298 (52.5%) of their fathers and 293 (51.6%) of their mothers were farmers and homemakers, respectively. The educational background of their parents revealed that 259 (45.6%) of their fathers and 131 (23.1%) of their mothers attended primary education (Table **2**).

### Nutritional and Health-Related Characteristics of Study Participants

In this study, 278 (49%) participants ate less than 3 times per day. About 207 (39.6%) of the study participants skipped one or more meals per day, and only 168 (29.6%) had adequate dietary diversity. Only 211 (37%) of the study participants were from food-secure households. Moreover, regarding health status, 149 (26.23%) of the study participants had a history of illness within 2 weeks prior to the study, and among them, 92 (61.7%) received treatment. Regarding hygiene and sanitation practices, 215 (37.85%) of the study participants used a latrine, and 298 (52.5%) washed their hands before meals (Table **3**).

### Prevalence of Stunting Among Adolescent Girls

The overall prevalence of stunting among adolescent girls in this study was found to be 39.6% (95% CI: 36.1–43.8). Out of this, 9% of the participants had severe stunting (Figure **1**).

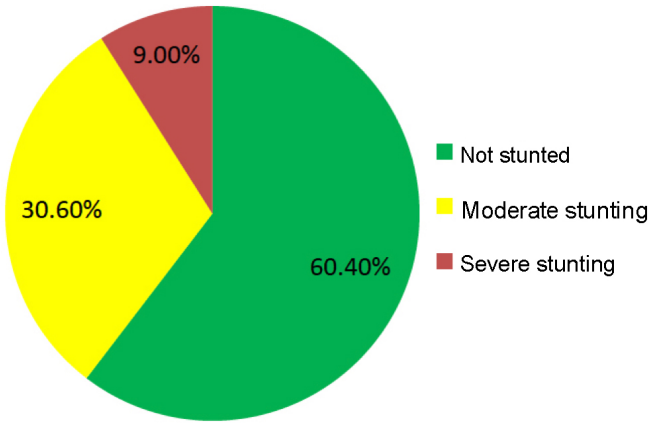


**Figure 1:** Level of stunting among Adolescent girls in Subhasaesie woreda, Tigray, Ethiopia (n=568), 2024.

### Factors Associated with Stunting Among Adolescent Girls

In the multivariable logistic regression, the food security status, family size, dietary diversity, age, and availability of a functional latrine were among the variables significantly associated with stunting ($p < 0.05$). Adolescent girls from food-insecure households had 8.5 times higher odds of stunting than those from food-secure households (AOR=8.5, 95% CI: 4.32, 16.83). The odds of stunting among adolescent girls who had ≥5 family members were 2.37 times higher than those who had a smaller family size (AOR=2.37, 95% CI: 1.38, 4.02). Adolescents with poor dietary diversity practice had 2 times the odds of being stunted compared with those with adequate dietary diversity practice (AOR=2.17, 95% CI: 1.17, 4.06). Moreover, late adolescent girls were 3 times more likely to develop stunting as compared to early adolescent girls (AOR=3.05, 95% CI: 1.81, 5.15) (Table **4**).

**Table 2: Socio-Demographic Characteristics of Female Adolescents at Subhasaesie District, Tigray, Ethiopia (N=568), 2024**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Age | Early Adolescent (10-14 years) | 319 | 56.2 |
| | Late Adolescent (15-19 years) | 249 | 43.8 |
| Ethnicity | Tigray | 434 | 76.4 |
| | Erob | 34 | 6.0 |
| | Afar | 37 | 6.5 |
| | Other | 63 | 11.1 |
| Religion | Orthodox | 419 | 73.8 |
| | Muslim | 39 | 6.9 |
| | Catholic | 39 | 6.9 |
| | Other | 71 | 12.5 |
| Father Occupation | Government Employee | 91 | 16.0 |
| | Farmer | 298 | 52.5 |
| | Daily Laborer | 50 | 8.8 |
| | Merchant | 68 | 12.0 |
| | Other | 61 | 10.7 |
| Mother Occupation | Government Employee | 52 | 9.2 |
| | Housewife | 293 | 51.6 |
| | Farmer | 108 | 19.0 |
| | Merchant | 56 | 9.9 |
| | Other | 59 | 10.4 |
| Fathers' Educational Status | Illiterate | 70 | 12.3 |
| | Primary School | 259 | 45.6 |
| | Secondary School | 160 | 28.2 |
| | Diploma and above | 79 | 13.9 |
| Mothers' Educational Status | Illiterate | 344 | 60.6 |
| | Primary School | 131 | 23.1 |
| | Secondary School | 58 | 10.2 |
| | Diploma and above | 35 | 6.2 |
| Family Size | Less than or equal to 5 | 303 | 53.3 |
| | Greater than 5 | 265 | 46.7 |

**Table 3: Nutrition and Health-Related Characteristics of Adolescent Girls in Subhasaesie District, Tigray, Ethiopia (N=568), 2024**

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Skipping regular meals | Yes | 207 | 36.4 |
| | No | 361 | 63.6 |
| Frequency of meals per day | ≥3 | 290 | 51.0 |
| | <3 | 278 | 49.0 |
| Dietary Diversity Score | ≥5 group | 168 | 29.6 |
| | <5 | 400 | 70.4 |
| Food Security Status | Food secure | 211 | 37.1 |
| | Food insecure | 357 | 62.9 |

**Table 3 (Continue)**

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Source of drinking water | Tape Water | 152 | 26.8 |
| | Spring Water | 141 | 24.8 |
| | Well | 216 | 38.0 |
| | River | 59 | 10.4 |
| Availability of functional latrine | Yes | 325 | 57.0 |
| | No | 243 | 43.0 |
| Latrine Utilization | Yes | 215 | 38.0 |
| | No | 353 | 62.0 |
| Washing your hands before a meal | Yes | 298 | 52.5 |
| | No | 270 | 47.5 |
| Illness within the last 2 weeks before the study | Yes | 149 | 26.2 |
| | No | 419 | 73.8 |

**Table 4: Factors Associated with Stunting During Bivariable and Multivariable Logistic Regression Analysis Among Adolescent Girls in Subhasaesie District, Tigray, Ethiopia(N=568),2024**

| Variable | Category | Stunting | | COR | AOR | P. value |
|---|---|---|---|---|---|---|
| | | Yes | No | | | |
| Food Security Status | Food in-secure | 206 | 151 | 13.79(8.23,23.10) | 8.5(4.32,16.83) | 0.001 |
| | Food secure | 19 | 192 | 1 | 1 | |
| Family Size | >5 | 155 | 110 | 4.49(3.27,6.74) | 2.37(1.38, 4.02) | 0.01 |
| | ≤5 | 70 | 223 | | 1 | |
| Age | Late Adolescent | 170 | 149 | 4.03(2.78,5.84) | 3.05(1.81, 5.15) | 0.001 |
| | Early adolescent | 55 | 194 | 1 | 1 | |
| Dietary Diversity Score | <5 | 196 | 204 | 4.61(2.95,7.19) | 2.17(1.16, 4.05) | 0.001 |
| | ≥5 | 29 | 139 | 1 | 1 | |
| Availability functional Latrine | No | 119 | 124 | 1.98(1.12,3.15) | 0.95(0.52,1.72) | 0.86 |
| | Yes | 106 | 219 | 1 | 1 | |
| Mother's Educational Status | Illiterate | 159 | 185 | 2.15(1.01,4.61) | .712 (.15, 3.43) | 0.67 |
| | Primary School | 38 | 93 | 1.13(.45,2.82) | .43(.10, 1.86) | 0.25 |
| | Secondary School | 18 | 40 | 1.02(.45,2.33) | .46 (.12, 1.80) | 0.26 |
| | Diploma and above | 10 | 25 | 1 | 1 | 0.54 |
| Occupation of Father | Other | 18 | 43 | 0.89(.44,1.81) | 0.89(.44, 1.81) | 0.75 |
| | Merchant | 18 | 50 | 0.77(.38,1.54) | 0.77(.38,1.54) | 0.461 |
| | Daily Laborer | 29 | 21 | 2.95(1.45,6.03) | 2.95(1.47,6.03) | 0.38 |
| | Farmer | 131 | 167 | 1.68(1.02,2.76) | 1.68(1.02,2.76) | 0.26 |
| | Government Employee | 29 | 62 | 1 | 1 | 0.122 |
| Hand washing before a meal | No | 154 | 116 | 4.24(2.96,6.08) | 1.7 (1.01,2.99) | 0.085 |
| | Yes | 71 | 227 | 1 | 1 | |

## DISCUSSION

This study was conducted to assess the prevalence of stunting and associated factors among female adolescents in the Subhasaesie district during the post-war period. According to this study, the prevalence of stunting among adolescent girls was found to be 39.6%. Food insecurity, family size≥5, low dietary diversity, and late adolescence were among the variables significantly associated with stunting.

The prevalence of stunting in this study is higher than that reported in a study in Myanmar at 23% [32]. Similarly, the prevalence of stunting in the current study is much higher than the findings from Ethiopian studies in Durame Town [33], North Shoa12.3% [34], Legehida district 24.9% [19], Aseko district 20.2% [35], Debark district 20.1% [20], and Addis Ababa (Ethiopia), 7.2% [36]. It is also higher than a previous study conducted in the Hawzen district, Tigray region (33.2%), and Adama Town, Oromia region 34.1% [37]. This discrepancy could be due to the difference in study period and the occurrence of drought. Additionally, the exceptionally high prevalence found in this study is likely exacerbated by the recent two-year conflict (2020-2022) in Tigray which severely disrupted food systems, damaged agricultural assets, limited market access, and impaired health and social services, key determinants of adolescent nutrition. And also, the Tigray war, which resulted in a lack of functional health facilities, significant economic loss, food insecurity, limited dietary diversity, and poor social protection [22, 24]. However, the prevalence in the current study was lower than that reported in a study conducted in Tanjungsari, West Java, Indonesia (48.8%) [38]. The possible explanation for the variation could be differences in study setting—the current study was conducted at a community, while the comparison study was conducted in institutions. Furthermore, it could be due to socioeconomic and cultural differences in dietary habits and care practices.

In this study, stunting was higher among late adolescents (15–19 years) than early adolescents (10–14 years). This finding is similar to the study conducted in the Somali region [39], North Shoa, Ethiopia [34], Damot Sore District, Southern Ethiopia [40], and Uttar Pradesh, Bihar, India [41]. This difference among age groups may have occurred because of the late age of adolescent in the study area's had more experiences of fasting for their religious purposes than earlier ages. Furthermore, the chronic and cumulative shortage of food might pose substantial challenges to the nutritional status of adolescent girls in later life.

Adolescent girls belonging to households with a larger family size of greater than five (>5) were more likely to become stunted compared to adolescents belonging to households with less than or equal to five family members. This finding is supported by a previous study in the Somali region [42], the Gudeya Bila district [6], and in the North Shoa zone, Ethiopia [34]. This correspondence may be due to a large family sharing the available food, a food security problem that is risky for stunting.

Adolescent girls from households facing food insecurity had greater chances of being stunted compared to those from food-secure households. This finding is in line with studies conducted in Gonder town, Debark, and Lideta Sub-city, Addis Ababa [20, 26, 36], and in Debark, North East Ethiopia [43]. This may be because food insecurity can limit access to preparing or consuming a diverse diet, which is nutrient-rich and high in protein and calories, helping prevent stunting.

This study revealed that dietary diversity is strongly associated with stunting. Adolescent girls having inadequate dietary diversity were more likely to develop stunting as compared to those with adequate dietary diversity scores. It agreed with the research done in North Shoa, Ethiopia [34].This could be because dietary diversity helps adolescents to access a variety of energy-dense nutrients and micronutrients.

Despite other studies showing that factors such as the mother's occupation [40, 44], jumping meal frequency [37, 44], and hand washing before a meal [37] were associated with stunting, this study did not find any association.

As strength this study was conducted during the post-war period at the community-level to enhance the precision of responses, and to show stunting levels after 2 years of conflict in the region and 1 season of drought in the zone, as well as in the district. It also used a validated tool to ensure data collection quality. As a limitation of this study, there might be recall bias and a lack of data on social protection to examine its temporal relationship with stunting. In addition, the cross-sectional design restricts the ability to establish a causal relationship between the identified factors and stunting, as exposure and outcome were measured at

the same time. This study did not address micronutrient deficiency and thinness, which are other critical aspects of under-nutrition, due to resource and time constraints, limiting a comprehensive assessment of nutritional burden. The absence of pre-war baseline data or a concurrent comparison group from a non-conflict region hampers precise attribution of the high prevalence solely to the post-war context, although the circumstantial evidence remains strong.

## CONCLUSIONS

The prevalence of stunting in this study was higher than in other studies. Food insecurity, large family size, poor dietary diversity practice, and being a late adolescent age were the determining factors affecting stunting among adolescents. Food insecurity and poor diet diversity during the post-war period might be aggravated because most farming tools were looted and damaged during the war. This study recommends strengthening the multisectoral and intersectoral system, including the food and agriculture system, ensuring the availability of reproductive health services, and implementing nutrition interventions at the district and regional levels, with support from the government, international NGOs, and other stakeholders.

## LIST OF ABBREVIATIONS

AOR = Adjusted Odds Ratio

BMI = Body Mass Index

COR = Crude Odds Ratio

CSA = Central Statistical Agency

CI = Confidence Interval

DDS = Dietary Diversity Score

DHO = District Health Office

DHS = Demographic and Health Survey

EDHS = Ethiopian Demographic and Health Survey

FANTA = Food and Nutrition Technical Assistance

FAO = Food and Agriculture Organization of the United Nations

HEWs = Health Extension Workers

HFIAS = Household Food Insecurity Access Scale

INGO = International Non-Governmental Organizations

SPSS = Statistical Package for Social Sciences

SD = Standard Deviation

UNICEF = The United Nations Children's Fund

WHO = World Health Organization

## ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

Ethical clearance prior to data collection was obtained from the Ethical Review Committee of the College of Medicine and Health Sciences, Adigrat University, with Ethical approval reference number: ERC/0013/2024. An official permission letter was also obtained from Subhasaesie District Health Office. Written informed consent or assent was obtained from all study participants after adequate information on the possible benefits and risks of the study was provided in the local language (Tigrigna). Additionally, for participants who were minors (under 18 years of age), consent was obtained from their parents.

## CONSENT FOR APPLICATION

Not applicable.

## AVAILABILITY OF DATA AND MATERIAL

The datasets used and or analyzed during this study are available from the corresponding author on reasonable request.

## COMPETING INTERESTS

The authors declare they have no competing interests.

## FUNDING

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## AUTHOR CONTRIBUTIONS

YT was the principal author, participating in the conceptualization, design, acquisition, analysis, and interpretation of the data; drafting the manuscript; and serving as the corresponding author. AKB was the

primary academic advisor, contributed for design, acquisition, analysis, and interpretation of the data, and critically revised the manuscript. MM, YG and BT had contributed for design, acquisition, analysis, and interpretation of the data and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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