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Research Article

Predictors of Stunting among 6–35 Months Old Children in Assosa Zone, Northwest Ethiopia: Unmatched Case–Control Study

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Background. In 2020, globally, 149.2 million under 5 years old children were stunted. In Africa, 61.4 million and 79 million under 5 years old children in Asia were also stunted in 2020. Stunting is a major public health problem in Ethiopia, where more than 5.5 million children under 5 years old are stunted. Stunting has irreversible and intergenerational health consequences, including impaired cognitive and physical growth, poor learning capacity, and reduced work productivity. Efforts to end stunting need comprehensive and context identification of risk factors. For this reason, this study aims to identify the predictors of stunting among children 6–35 months of age in Northwest Ethiopia. *Method*. A community-based, unmatched case–control study was employed in the Assosa zone, Benishangul Gumuz, west Ethiopia. A multistage and simple random sampling technique was used to select the study participants. Data were collected through interviewer-administered questionnaires using validated structured questionnaires and anthropometric measurements. Data were entered into Epidata version 3.1 and exported to SPSS 25.0 statistical software for analysis. Bivariate and multivariate analyses were computed. Finally, an adjusted odds ratio (AOR) with a 95% confidence interval (CI) was used to identify independent predictors of stunting using a multivariable logistic regression model. *Result*. The study included 544 mother–child pairs (181 cases and 363 controls), with a 100% response rate. The majority of the mothers, 85 (47.0%) in the case and 153 (42.1%) in the control group, were in the 25- to 29-year-old age group. This study revealed that mothers who had no formal education (AOR = 2.5, 95% CI (1.436, 4.180)), short maternal height (<150 cm) (AOR = 4.25, 95% CI (2.714, 6.663)), exclusive breastfeeding for less than 6 months (AOR = 3.16, 95% CI (1.97, 5.10)), minimum dietary diversity (AOR = 3.09, 95% CI (1.97, 5.01)), additional food during pregnancy (AOR = 2.26, 95% CI (1.44, 3.5)) and food security (AOR = 3.08, 95% CI (1.79, 5.26)) were found to be independently statistically associated with child stunting. *Conclusion and Recommendation*. This study revealed that the predictors of stunting among children aged 6–35 months were multifactorial, which calls for an integrated and multisectoral intervention to reduce or eliminate stunting. Mothers' factors, educational status, additional food during pregnancy, and child feeding, including dietary diversity and exclusive breastfeeding, were modifiable predictors of child stunting. Therefore, we call for promoting mothers' education, creating awareness among mothers about optimum infant and young child feeding, specifically exclusive breastfeeding, and promoting mothers' practices of dietary diversity feeding.

What is already known about this study

(i) Poor child feeding in size and frequency is known as a factor of stunting among children.
(ii) Sanitation and infections are the other known predictors of stunting among children.

What this study adds

(i) This study explores the social determinants of stunting, which are the most predictors of stunting in low-income countries.
(ii) This study revealed that stunting is an intergenerational health problem.

How this study might affect research, practice, and/or policy

(i) This study helps the healthcare system and health program planer to incorporate those identified risk factors of stunting among children in their nutrition intervention program.
(ii) This study finding helps health professionals and other nongovernmental directly intervene to identify risk factors through nutritional health education so that the incidence of stunting will be decreased.
(iii) This study may be used as the baseline for future research.

1. Introduction

Children are stunted if their length/height is below −2 SDs height-for-age (HFA) < -2 SD) from the World Health Organization (WHO) Child Growth Standards median for the same age and sex [1]. Stunting is mostly irreversible by year three if it often occurs within the first 2 years of life [2]. The report shows that globally, about 149.2 million children, or 22% of under-5-year-old children, were stunted in 2020 [3]. The majority of stunted children were from Africa (61.4 million) and Asia (79 million) [3, 4]. The magnitude of stunting among under-5-year-old children is declining in all regions except Africa [5]. Evidence indicates that if the current reduction rates continue, there will be 127 million stunted children by 2025, a reduction of only 26% [6].

Ethiopia was categorized as having a very high prevalence in the region of the world in the joint report of 2020, which accounts for 35.3% of under 5-year-old children in Ethiopia being stunted [7]. The stunting reduction was a slow rate in Ethiopia between 2016 and 2019. In Ethiopia, based on the Ethiopia Demographics Health Survey (EDHS) 2016 report and the Ethiopian Mini Demographic Health Survey of 2019, about 38% [8] and 37% [9] of under-5-year-old children were stunted, respectively. In the study area, the prevalence of stunting among children under 5 years was as high as 44%, categorized as a very high prevalence [8]. The majority of stunted children (45%) were observed in the range of ages 24–35 months [9].

Stunting has adverse short and long-term health problems [10, 11]. Long-term health problems of stunting are decreased cognitive and motor development, resulting in poor learning capacity [12–14] and low school achievement [15]. A study done in Jamaica revealed that stunted children were found to have a higher risk of developing anxiety and depression than nonstunted children at the age of adolescence [16]. Stunted children are at a higher risk of developing infections and noncommunicable diseases [17]. An adult who was stunted during childhood has low economic productivity at individual, household, and community levels [10, 18, 19]. Stunting is characterized by its irreversibility [20] and intergenerational consequences; mothers who were stunted during their childhood are at greater risk of giving birth to stunted children in the future [1]. However, evidence indicates that children who experience linear growth failure before the age of 2–3 years may catch up on linear growth during adolescence if an early intervention has been taken [21, 22]. Evidence from Ethiopia, India, Peru, and Vietnam found that around 50% of children who were stunted at age 1 year showed improvements in height and were no longer stunted at age 8 years [23–25].

Stunting is a global health priority concern that receives international attention due to its magnitude, irreversible and long-term health consequences, intergenerational health problems, and economic consequences [20]. WHO's Global Nutrition Targets aimed for a 40% reduction in the number of children under 5 years who are stunted by 2025 [18]. Stunting is also included in the Sustainable Development Goal, which states that by 2030, end all forms of malnutrition, including meeting internationally agreed-upon targets for stunting in children under the age of five by 2025 [26]. At the national level, Ethiopia launched the Seqota Declaration, which aims to end childhood stunting by 2030 [27]. Even though the Ethiopian government has been implementing different interventional strategies to reduce stunting in the past few years, stunting remains a significant public health problem in the country [28]. Stunting is caused by many different factors that vary according to the geographic, ethnic, and socioeconomic contexts and segments of society [29]. Growth failure arises from complex environmental, social, and biological causes that are interlinked at various levels [30].

This study was conducted to address the three problem areas related to stunting among children. The first is that stunting is influenced by geographical, social, and demographic characteristics of the population that may continue to hinder related efforts to reduce or end stunting [29]. The World Health Organization recommends that to achieve the global stunting target for 2025, countries should begin by assessing the determinants of stunting in specific geographical and social contexts so that actions are taken to address contextual needs [18]. The second is the high prevalence of stunting among under-5-year-old children in the region of the study area and the slow reduction of stunting, which could be due to a lack of context-based, evidence-based interventions. The third is that, to the best of our knowledge, there is a lack of timely and reliable data on the risk factors

Table 1: Sample size determination using significant variables from previous research.

Significant variable	Power	% CI	Ratio of case to control	Percent of exposure (%)		Sample size		Total sample size
				Case	Control	Case	Control	
Exclusive breastfeeding	80	95	1 : 2	74.4	58	108	215	323
Dietary diversity	80	95	1 : 2	94.12	82.69	109	218	327
Minimum meal frequency	80	95	1 : 2	16.2	4	78	156	234

associated with stunting among children in the study area. For this reason, efforts to identify the predictors of stunting for appropriate intervention are needed. So, to end stunting, it is important to identify all possible determinants in different geographical, socioeconomic, social, and demographic characteristics of the population. This study was conducted to identify the predictors of stunting among children under 3 years that can contribute to evidence-based interventions to end stunting in Ethiopia and globally.

2. Materials and Methods

2.1. Study Design and Setting. The community-based unmatched case–control study design was conducted from January to April 2022. The study was conducted in the Assosa Zone, in Benishangul Gumuz's Region, West Ethiopia, among randomly selected 6–35-month-old children with their mothers or caregivers living in selected kebeles in the four selected districts during the study period. Benishangul-Gumuz regional state is located at 10°46′49.04 north latitude and 35° 33′56.83 east longitude globally. The Benishangul-Gumuz regional state is located in the western part of Ethiopia. It shares borders with Sudan in the northeast, the regional state of Amhara in the east, and the Oromia regional state in the south. The region comprises three zones (Assosa, Kamashi, and Metekel), one special woreda (Mao Komo), and one town administration (Assosa Town). Currently, the Assosa zone has eight districts: Assosa, Bambasi, Homosha, Kurmuk, Menge, Udulu, Oda Buldigilu, and Sherkole. Among these districts in the zone, four districts were randomly selected for this study. The selected districts are the Bambasi district, Menege districts, Kurmuk districts, and Homosha districts.

2.2. Inclusion and Exclusion Criteria. Cases were randomly selected children among 6–35-month-old children in the districts with a *Z*-score of length/HFA less than –2 SD based on WHO growth reference. Controls were randomly selected children from children of 6–35 months in the district with a *Z*-score of height/length-for-age greater than –2 SD based on WHO growth reference. Children with known underlying chronic illnesses and congenital abnormalities were excluded from the study.

2.3. Sample Size Determination and Sampling Procedure. Sample size determination was estimated by using significant variables from previous research. The used variables are exclusive breastfeeding [31], dietary diversity [32], and minimum meal frequency [33] (Table 1).

The sample size was calculated using two population proportion formulas by using the Epi info version 7.1 software sample size calculation using the following assumptions: From Table 1, different significant variables that were associated with stunting from previous literature were used to estimate the sample size. The final sample size for data collection was calculated using a large variable sample size from Table 1. The proportion of exposure among cases (stunted) was $p = 94.12\%$ and $p = 82.69\%$, which is the proportion of exposure among nonstunted children to inadequate dietary diversity (95% confidence interval (CI)), 80% power, and a case-to-control ratio of 1 : 2. Then the sample size was 109 cases and 218 controls, for a total of 327 total sample sizes. Due to the design effect of the multistage sampling, case and control were multiplied by 1.5. For a nonresponse rate, 10% was considered. Finally, the total sample size was 544 (181 cases and 363 controls).

2.4. Sampling Techniques. A multistage and simple random sampling method was used to select the study participants. Among the four zones in the region, the Assosa zone was randomly selected. From the selected zone (Assosa zone), there are six districts, of which four are again randomly selected. House-to-house enumeration and registration were done for 7,687 households who had children aged 6 months to 35 months in the selected districts. Anthropometric measurements of children 6 and 35 months of age were taken, and they were measured for their *Z*-score of height for age reference. In the selected districts, 7,687 children were secerned for their Anthropometric status of being stunted or not. Then, children were labeled into two groups, 2,371 stunted (case) and 5316 nonstunted (control). Sampling frames were prepared for cases and controls before the actual data collection. The total sample size was proportionally allocated to selected districts based on the size of the children ages 6–35 months in each district. Simple random sampling was employed to select each child in the selected districts. For the final data collection, the case group (stunted children) was randomly selected using the simple random sampling method among the stunted children, and similarly, the control group (nonstunted children) was selected by applying simple random sampling among eligible nonstunted children. During data collection, for each case in each district, two controls were selected, and this procedure was continued until the calculated sample size was attained (the control-to-case ratio was 2 : 1). For more than one eligible child (6–35 months) in the household, the lottery method was employed to select one child.

2.5. Data Collection Tool and Procedures. Data were collected by face-to-face interviews using a standard structured questionnaire adapted from WHO and United Nations Children's Education Fund (UNICEF) data, the EDHS 2016, and previous similar published literature that was employed for the assessment of child malnutrition [30, 34–38]. A structured questionnaire was designed that enables assessments of the required information, including sociodemographic and economic factors, maternal and child factors, infant and young child feeding practice (IYCF) factors, household food security based on the Household Food Insecurity Access Scale (HFIAS), and environmental health factors such as water, sanitation, and hygiene (WASH). The questionnaire was initially prepared in English, translated into the local language (Amharic) for fieldwork purposes, and then retranslated by another person back to English to check language consistency. Before the actual data collection, 5% of the sample size was pretested with nonselected participants. The data collection has two phases. In the first phase, the children were assessed for nutritional status using anthropometric measurements and grouped into two groups: stunted and nonstunted. Each child was labeled with a unique code. In the second phase, by using a unique code, children were assessed for the predictors of stunting using a standard structured questionnaire.

2.6. Anthropometric Measurements. Anthropometric measurements were measured by trained health professionals and field assistants. Height and length were measured using a standardized horizontal wooden length and a vertical wooden height board, respectively. The length of children aged 6 and 23 months was measured in the recumbent position without shoes to the nearest 0.1 cm by using a horizontal wooden length board. A vertical wooden height board was used to measure the height of children between 24 and 35 months of age. The height of children between the ages of 24 and 35 months was measured by making a child stand up in the center of the board without shoes. Anthropometric measurement was taken after the child's head, shoulders, buttocks, knees, and heels were adjusted to touch the board. Each measurement was taken three times to ensure the reliability of the study. Finally, anthropometric measurement values of length and height were used the closest to 0.1 cm.

2.7. Variable Measurements. Stunting was defined as a child with a height-for-age Z-score (HAZ) less than minus two standard deviations (<−2 SD) using the WHO reference.

2.8. Length and Height. The length of children aged 6 and 23 months was measured in the recumbent position by using a horizontal wooden length board without wearing shoes to the nearest 0.1 cm.

The height of children between the ages of 24 and 35 months was measured by making the child stand up in the center of the board without wearing shoes using a vertical wooden height board, and the measured value is to the nearest 0.1 cm.

2.8.1. Food Insecurity. The food security status of the households was determined based on nine standard HFIAS questions. HFIAS questions were developed for this purpose by Food and Nutrition Technical Assistance in 2007 for a developing country. Based on HFIAS, household food security was categorized as food secure, mild food insecure, moderate food insecure, and severe food insecure [39].

2.8.2. Minimum Dietary Diversity. Dietary diversity is a proxy of optimal feeding for infants and young children (aged 6–23 months). *Minimum dietary diversity* is the consumption of at least four or more of seven food groups: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin-A-rich fruits and vegetables; and (7) other fruits and vegetables, in the last 24 hr of the assessment [40].

2.8.3. Minimum Meal Frequency. The proportion of breastfeeding and nonbreastfeeding children aged 6–23 months who receive soft, solid, and semisolid foods (but also including milk feeds for nonbreast feed children) in the last 24 hr [41].

2.9. Data Quality Management. The questionnaire was prepared in English and then translated into the local language (Amharic) and then translated back to English to ensure consistency. Data collectors and supervisors were trained on the questionnaire to understand the objective of the study, how to interview (procedures of data collection), and how to perform standardized anthropometric measurements. Health professionals who had more experience or who had training in anthropometric measurement and nutritional assessment were used as supervisors and data collectors. Before the actual data collection, the questionnaire was pre-tested with 5% of the sampled population similar to the study area. For each case and control, participants were given a unique code, so the data collector was not known to the case or control individual. There was strict supervision of the data collection process, consistency, and completeness of questionnaires daily. The overall data collection process was controlled by the principal investigator. The filled questionnaires were checked and cleaned daily. The data were used for analysis after being checked and cleaned for inconsistencies and missing values.

2.10. Data Processing and Analysis. The data were entered into Epidata version 3.1 and exported to SPSS version 25 for analysis. Descriptive statistics were computed. Binary and multivariable logistic regressions were computed. A multivariable logistic regression model was computed to identify potential significant predictors of stunting. Bivariate logistic regression was performed. Hosmer and Lemeshow's goodness-of-fit test was done to check the model fit, and the Hosmer–Lemeshow test found the p-value was 0.56, insignificant, showing a good model fit. Multicollinearity between independent variables was checked using the variance inflation factor, and there was no multicollinearity. Interaction (effect modification) was checked among independent variables, and there was no interaction. A variable with a p-value ≤ 0.25 in binary logistic regression was transferred to multivariate logistic regression for final modeling to identify the predictors. In the multivariable logistic regression analysis, variables with a p-value < 0.05 were taken as statistically significant factors. Finally, statistical significance was declared at 95% CI with a corresponding adjusted odds ratio (AOR) to assess the association between the factors and stunting.

Anthropometric data were analyzed using WHO Anthro Plus version 1.0.4 statistical software to derive nutrition indices (HAZ). Then, children whose HAZ were <−2 SD of their reference mean were classified as stunted, and children whose HAZ ≥ −2 SD were not stunted.

2.11. Ethical Consideration. Ethical clearance was obtained from the ethical Institution review board of Assosa University (ASU/IRB/016/14). Letters of permission were obtained from the Benishangul Gumuz Health Bureau and the selected district health office. After the objective and procedure of the study were explained to parents, written informed consent was obtained from every participant's parent or guardian before conducting the survey. Participant's parents or guardians were told the results of the study would be kept confidential, and the privacy of the respondent was maintained.

3. Result

3.1. Demographics and Socioeconomic Characteristics of Children among 6–35 Months in Assosa Zone, Northwest Ethiopia 2022. The study included a total of 544 mother–child pairs (181 cases and 363 controls) with a 100% response rate. The majority of the mothers, 85 (47.0%) in the case group and 153 (42.1%) in the control group, were in the 25–29 years old age group. Regarding the educational status of mothers, the majority of the mothers of children in the study participants, 141 (77.9%) in the cases group and 244 (67.2%) in the control group had no formal education. About 105 (58.0%) of the children in the case group were female, and 186 (51.2%) of the children in the control group were male. The majority of the children in case 97 (53.6%) were in the 24–35 months age group, and 167 (46.0) of the control were in the 24–35 months age group (Table 2).

3.2. Maternal and Childcare Characteristics. This study showed that 132 (72.9%) mothers of stunted children and 314 (86.5%) mothers of nonstunted children had ANC follow-up. This study found 90 (68.7%) cases and 214 (68.2%) control group children's mothers had 2–3 times ANC visits. Mothers from the 120 (66.3%) case group and 250 (68.9) control group had not attended postnatal care visits. Regarding additional feeding during pregnancy by mothers of children, this study showed that 120 (66.3%) of mothers of children in the case group and 159 (43.8%) of mothers of children in the control group had no additional feeding during their pregnancy (Table 3).

3.3. Infant Young Child Feeding and Food Insecurity Factors. Among the children who were assessed for infant and young child feeding, 118 (65.2%) of the cases and 130 (35.8%) of the controls had a duration of exclusive breastfeeding of fewer than 6 months. Among the children 6–23 months who were assessed for minimum dietary diversity (MDD), 113 (62.4%) of the cases and 114 (31.4%) of the controls had less than 4 minimum dietary diversity. For the duration of breastfeeding duration, among 245 children aged two to 3 years, 49 (57.6%) cases were fed on breast milk for less than 2 years, and 87 (54.4%) controls were fed on breast milk for greater than or equal to 2 years. Regarding household food security, 137 (75.7%) of the cases and 168 (46.3%) of the controls were food insecure (Table 4).

3.4. Environmental and Health Facility-Related Factors. This study revealed that among the study participants, 42 (23.2%) cases and 57 (15.7%) controls had no functional latrines. Among the households of children in this study who had functional latrines, about 118 (84.9%) of the cases and 245 (80.1%) of the controls had no hand-washing facility near a latrine. Regarding the source of drinking water, 69 (38.1%) of cases and 67 (18.5%) of controls had an unprotected water supply (Table 5).

3.5. Predictors Variable Associated with Stunting among 6–35-Month-Old Children in Assosa Zone, Northwest Ethiopia 2022. This study found that multivariate logistic regression analysis identified multiple predictor factors that were independently significantly associated with stunting. This study revealed that mothers' educational status (AOR = 2.5, 95% CI (1.436, 4.180)), mother's height (cm) (AOR = 4.25, 95% CI (2.714, 6.663)), duration of exclusive breastfeeding (AOR = 3.16, 95% CI (1.97, 5.10)), minimum dietary diversity (AOR = 3.09, 95% CI (1.97, 5.01), additional food during pregnancy (AOR = 2.26, 95% CI (1.44, 3.5)), and food security (AOR = 3.08, 95% CI (1.79, 5.26) were found to be independently statistically associated with stunting among the study participants (Table 6).

4. Discussion

This study found that predictors of stunting were multiple factors, including maternal factors, child feeding, and social factors. From the multivariable logistic regression analysis model, predictors of stunting among children in this study were mothers who had no formal education (AOR = 2.5, 95% CI (1.436, 4.180)), short maternal height (<150 cm) (AOR = 4.25, 95% CI (2.714, 6.663)), duration of exclusive breastfeeding less than 6 months (AOR = 3.16, 95% CI (1.97, 5.10)), less than four types of DDS (AOR = 3.09, 95% CI (1.97, 5.01), no additional food during pregnancy (AOR = 2.26, 95% CI (1.44, 3.5)), and food insecurity (AOR = 2.8 (1.7, 4.6)) were found to be independently statistically significant associated with stunting among the study participants.

This study's findings revealed that mothers' education status had an independent association with childhood stunting. Children born to mothers with no formal education were 2.5 times more likely to be stunted than children born to mothers with formal education (AOR = 2.5, 95% CI (1.436, 4.180)). This study's finding was in line with the other different studies conducted in Ethiopia: the 2016 EDHS [42], Hossana, Southern Ethiopia [43], Afar Region [44], and Sidama Region [38]. This study also agreed with the study conducted in different parts of the world, Tanzania [45], Urmia, Northwest Iran [46], and Nigeria [47]. This could be explained as educated mothers would have good

Table 2: Demographics and socioeconomic characteristics of children among 6–35 months in the Assosa zone, Northwest Ethiopia 2022.

Variables	Nutritional status of children		Total (%)
	Case (%)	Control (%)	
Ethnicity of mothers or caregivers			
Benishangul (beta)	89 (49.2)	185 (51.0)	274 (50.4)
Oromo	34 (18.8)	711 (9.6)	105 (19.3)
Shinasha	10 (5.5)	19 (5.2)	29 (5.3)
Amhara	48 (26.5)	88 (24.2)	136 (25.0)
The religion of mothers or caregivers			
Muslim	116 (64.1)	256 (70.5)	372 (68.4)
Orthodox	43 (23.8)	63 (17.4)	106 (19.5)
Protestant	22 (12.2)	44 (12.1)	66 (12.1)
The age group of mothers			
18–24 years	46 (25.4)	114 (31.4)	160 (29.4)
25–29 years	85 (47.0)	153 (42.1)	238 (43.8)
30–34 years	38 (21.0)	77 (21.2)	115 (21.1)
35–45 years	12 (6.6)	19 (5.2)	31 (5.7)
Occupation status of mothers or caregivers			
Farmer	149 (82.3)	307 (84.57)	456 (83.8)
Gov. employed	7 (3.9)	13 (3.6)	20 (3.7)
Marchant	6 (3.3)	22 (6.1)	28 (5.1)
Daily laborer	16 (8.8)	6 (1.7%)	22 (4.0)
Housewife	3 (1.7)	15 (4.1)	18 (3.3)
Occupation status of husband			
Farmer	158 (87.3)	316 (87.1)	474 (87.1)
Gov. employed	15 (8.3)	26 (7.2)	41 (7.5)
Marchant	7 (3.9)	15 (4.1)	22 (4.0)
Daily laborer	1 (0.6%)	6 (1.7)	7 (1.3)
Educational status of mothers			
No formal education	141 (77.9)	244 (67.2)	385 (70.8)
Formal education	40 (22.1)	119 (32.8)	159 (29.2)
Households' family member's size			
≤4	133 (73.5	225 (62.0)	358 (65.8)
>4	48 (26.5)	138 (38.0)	186 (34.2)
Sex of child			
Male	76 (42.0)	186 (51.2)	262 (48.2)
Female	105 (58.0)	177 (48.8)	282 (51.8)
Age of child			
6–11 months	19 (10.5)	41 (11.3)	60 (11.0)
12–23months	65 (35.9)	155 (42.7)	220 (40.4)
24–35 months	97 (53.6)	167 (46.0)	264 (48.5)
Number of under five in the households			
≤2	142 (78.5)	323 (89.0)	465 (85.5)
≥3	39 (21.5)	40 (11.0)	79 (14.5)

knowledge and practice of feeding their children with dietary diversity as compared to uneducated mothers. Maternal education has an impact on how mothers choose nutritious foods for their children that are rich in micronutrients. Infection is one of the immediate causes of malnutrition. So, maternal education increases their knowledge of sanitation and hygiene, which decreases the risk of child infection. Also, maternal educational status affects maternal attention to children care for utilization of appropriate health care services like immunization and vitamin supplementation, which in turn affects stunting.

Children born to short mothers (height < 150 cm) were 4.2 times more likely to be stunted as compared to children born to short mothers (height ≥ 150 cm) (AOR = 4.25, 95% CI (2.714, 6.663)). This was consistent with the study done in Ethiopia's Tigray Region [48], Afar region, North East Ethiopia [44], Vietnam [49], Nepal [50], Pakistan [51], Brazilian Amazon [52], and Bangladesh [53]. This might be because

Table 3: Maternal and child care characteristics of children among 6–35 months in Assosa zone, Northwest Ethiopia 2022.

Variable	Case (%)	Control (%)	Total (%)
ANC visits			
Yes	132 (72.9)	314 (86.5)	446 (82.0)
No	49 (27.1)	49 (13.5)	98 (18.0)
Number of ANC visits			
1	4 (3.1)	15 (4.8)	19 (4.3)
2–3	90 (68.7)	214 (68.2)	304 (68.3)
≥ 4	37 (28.2)	85 (27.1)	122 (27.4)
Place of delivery			
Hospital	37 (20.4)	77 (21.2)	114 (21.0)
Health center	113 (62.4)	226 (62.3)	339 (62.3)
Home	31 (17.1)	60 (16.5)	91 (16.7)
PNC visit			
Yes	57 (31.5)	113 (31.1)	170 (31.3)
No	124 (68.5)	250 (68.9)	374 (68.8)
Additional food during pregnancy			
Yes	61 (33.7)	204 (56.2)	265 (48.7)
No	120 (66.3)	159 (43.8)	279 (51.3)
Additional food during lactation			
Yes	61 (33.7)	204 (56.2)	265 (48.7)
No	120 (66.3)	159 (43.8)	279 (51.3)
Birth interval			
<24 months	90 (49.7)	117 (32.2)	207 (38.1)
≥24 months	91 (50.3)	246 (67.8)	337 (61.9)

Table 4: Child feeding and food security factors of children 6–35 months in Assosa zone, Northwest Ethiopia 2022.

Variable	Case (%)	Control (%)	Total (%)
Duration of exclusive breastfeeding			
Less than 6 months	118 (65.2)	130 (35.8)	248 (45.6)
At 6 months	63 (34.8)	233 (64.2)	296 (54.4)
Duration of breastfeeding for children			
<24 months	149 (82.3)	234 (64.5)	383 (70.4)
≥24 months	32 (17.7)	129 (35.5)	161 (29.6)
Minimum dietary diversity of children			
Less than 4 type	113 (62.4)	114 (31.4)	227 (41.7)
4 and above type	68 (37.6)	249 (68.6)	317 (58.3)
Minimum meal frequency			
2 times	56 (58.3)	39 (19.2)	95 (31.8)
3 and above times	40 (41.7)	164 (80.8)	204 (68.2)
Households' food security status of HFIAS			
Food insecure	137 (75.7)	168 (46.3)	305 (56.1)
Food secured	44 (24.3)	195 (53.7)	239 (43.9)

short maternal height is linked to intrauterine growth retardation, which is, in turn, a predictor of stunted child development. The short stature of the mother and maternal undernutrition increases the risk of intrauterine growth retardation [48]. Again, maternal short stature can limit uterine blood flow, the growth of the uterus, placenta, and

Table 5: Environmental and health facility-related factors of children among 6–35 months in Assosa zone, Northwest Ethiopia 2022.

Variable	Case (%)	Control (%)	Total (%)
Do you have a functional latrine?			
Yes	139 (76.8)	306 (84.3)	445 (81.8)
No	42 (23.2)	57 (15.7)	99 (18.2)
Hand washing facility near to latrine			
Yes	21 (15.1)	61 (19.9)	82 (18.4)
No	118 (84.9)	245 (80.1)	363 (81.6)
Water sources			
Protected	112 (61.9)	296 (81.5)	408 (75.0)
Unprotected	69 (38.1)	67 (18.5)	136 (25.0)
Treatment of water for drinking/cooking?			
Yes	36 (19.9)	76 (20.9)	112 (20.6)
No	145 (80.1)	287 (79.1)	432 (79.4)
Use appropriate solid waste disposal method			
Yes	104 (57.5)	215 (59.2)	319 (58.6)
No	104 (57.5)	215 (59.2)	319 (58.6)
Use appropriate liquid waste disposal methods.			
Yes	104 (57.5)	216 (59.5)	320 (58.8)
No	77 (42.5)	147 (40.5)	224 (41.2)
Did the child have diarrhea during the last 2 weeks?			
Yes	57 (31.5)	111 (30.6)	168 (30.9)
No	124 (68.5)	252 (69.4)	376 (69.1)
Immunization status for the recommended age			
Yes	157 (86.7)	310 (85.4)	467 (85.8)
No	24 (13.3)	53 (14.6)	77 (14.2)
Deworming of the child in the last 6 months			
Yes	52 (28.7)	101 (27.8)	153 (28.1)
No	129 (71.3)	262 (72.2)	391 (71.9)

fetus development, resulting in intrauterine growth retardation and child stunting [48].

The nutritional status of mothers appeared to be associated with stunting among children. The odds of being stunted among children whose mothers had no additional food during pregnancy were about 2.69 times higher as compared with their counterparts (AOR = 2.69, 95% CI (1.67, 4.35)). This finding is consistent with prior studies, which stated that the poor nutritional status of mothers before and during pregnancy was associated with stunted children in northeastern Ethiopia [54] and Tanzania [55]. This might be because inadequate nutrition during pregnancy is associated with insufficient nutrient transfer to the fetus, which accounts for a large proportion of growth retardation in the fetal environment. This would result in a decreased birth weight and growth impairment in the child in later life.

According to this study's findings, some indicators of infant and young child feeding have been identified as predictors of child stunting. This study found that children who had no exclusive breastfeeding during the first 6 months were more likely to be stunted compared to their counterparts. The odds of stunting were higher among children who were not exclusively breastfed in the first 6 months as compared to their counterparts.

Table 6: Bivariate and multivariate logistic regression analysis to identify the predictor variable independently associated with stunting among 6–35-month-age children in Assosa zone, Northwest Ethiopia 2022.

Variables	Case number (%)	Control number (%)	p-Value	COR (95% CI)	p-Value	AOR (95% CI)
Educational status of mothers						
No formal education	141 (77.9)	244 (67.2)	0.001	3.0 (1.93, 4.66)	0.001	2.5 (1.436, 4.180)*
Formal education	40 (22.1)	119 (32.8)			1	
Family size of households						
≤4	133 (73.5)	225 (62.0)		1		
>4	48 (26.5)	138 (38.0)	0.008	1.69 (1.15, 2.5)	0.21	1.(1.0, 2.917)
Number of under five in the HHS						
≤2	142 (78.5)	323 (89.0)		1		
≥3	39 (21.5)	40 (11.0)	0.001	2.22 (1.37, 3.6)	0.151	1.15 (.85, 2.8)
Sex of children						
Female	105 (58.0)	177 (48.8)	0.042	1.45 (1.01, 2.08)	0.116	1.34 (0.90, 2.4)
Male	76 (42.0)	186 (51.2)			1	
Mother height (cm)						
<150 cm	122 (67.4)	126 (34.7)	0.0001	3.9 (2.66,5.68)	0.0001	4.25 (2.714, 6.66)*
≥150 cm	59 (32.6)	237 (65.3)			1	
Exclusive breastfeeding						
Less than 6 months	118 (65.2)	130 (35.8)	0.001	2.65 (1.78, 3.95)	0.001	3.16 (1.97, 5.10)*
At 6 months	63 (34.8)	233 (64.2)			1	
Birth interval						
<24 months	90 (49.7)	117 (32.2)	0.020	2.09 (1.4, 2.99)	0.076	1.05 (0.964, 2.502)
≥24 months	91 (50.3)	246 (67.8)				
Minimum dietary diversity						
<4	113 (62.4)	114 (31.4)		3.63 (2.45, 5.27)	0.001	3.09 (1.97, 5.01)*
≥4 (ref.)	68 (37.6)	249 (68.6)			1	
Meal frequency						
<4	56 (58.3)	39 (19.2)		4.86 (3.30, 7.14)	0.001	5.830 (3.5, 9.6)*
≥4	40 (41.7)	164 (80.8)		1		
Additional food during pregnancy						
Yes	61 (33.7)	204 (56.2)			1	
No	120 (66.3)	159 (43.8)		2.54 (1.74, 3.66)	0.0001	2.26 (1.44, 3.55)*
Food security (HFIAS score)						
Food insecure	137 (75.7)	168 (46.3)		3.61 (2.43, 5.37)	0.0001	3.08 (1.79, 5.26)*
Food secured	44 (24.3)	195 (53.7)			1	

Note: *Variable statistically significantly associated at $p \leq 0.05$, AOR: adjust odd ratio, COR: Crud odd ratio, CI: confidence interval.

Children who had exclusively breastfed for less than 6 months had three times greater odds of being stunted as compared with children with exclusive breastfeeding for 6 months or more (AOR = 2.91, 95% CI (1.762, 4.814)). The finding agreed with the different studies conducted in the Gurage Zone [56], Afar region [44], Northeast Ethiopia [54], Araba Minch [57], and Sidama region [38]. This study's finding is also in line with studies conducted in different parts of the world, Nigeria [47], Jombang, East Java [58], and Indonesia [59]. This could be because the short period of breastfeeding is not sufficient to provide adequate protein and micronutrients for optimal physical growth. The other possible explanation is that early initiation of complementary feeding might introduce gastrointestinal infections and intestine ulcers, which decrease micronutrient absorption and result in stunting [60].

This study found that a dietary diversity score (DDS) of less than four types was statistically significant for stunting. The odds of stunting were three times more likely among children who had DDS less than 4 as compared to children with DDS greater or equal to 4 (AOR = 3.11, 95% CI, (1.93, 5.01). This study's findings are consistent with those of previous studies, Tigray region [48], Kenya [61], Nigeria [62], Indonesia [59, 63, 64], and Bangladesh [65]. According to UNICEF's framework of malnutrition, stunting can be directly caused by inadequate intake of nutritious food. If poor dietary diversity happens over the long term, it increases the risk of stunting among children. This could be due to inadequate access to vital nutrients and caloric intake, which result in poor development during early childhood.

This study found that meal frequency of less than four types was found statistically significant for stunting. The odds of stunting were about six times more likely found among children who had meal frequency less than 4 as compared to children with meal frequency greater or equal to 4 per day (AOR = 5.830, 95% CI, (3.5, 9.6)). This study finding agreed with the study findings in Sodo Zuria District, South Ethiopia [66] and West Guji Zone, Oromia, Ethiopia [67]. This could be attributed to low meal frequencies resulting in low nutrition intake, leading to undernutrition, specifically stunting.

The study found that household food security status had a significant association with stunting. It indicated that children from food-insecure households were three times more likely to be stunted compared with children from food-secured households (AOR = 3.08, 95% CI (1.79, 5.26)). This study finding is supported by study findings conducted in Ethiopia, EDHS conducted in 2016 [68] and southern Ethiopia [9], West Guji Zone, Oromia [67], and Kenya [61, 69].

This could be a household with food insecurity that has no access to sufficient nutritious food, which results in poor physical growth in the child. Evidence indicates that the consumption of nutrition-rich foods depends on food availability in households [70]. The other justification may be that poverty hinders the household's financial ability to access food, which is a contributing factor to poor households' food security and results in stunting among children.

5. Conclusion

This study revealed that the predictors of stunting among children aged 6–35 months were multifactorial. This study has shown that the independent predictors for stunting were maternal education status, short maternal height, exclusively breastfeeding before 6 months, duration of breastfeeding less than 24 months, minimum dietary diversity, no additional food during pregnancy, and food security, which were found to be independently statistically associated with child stunting.

Based on the findings of this study, we conclude that promoting maternal awareness or knowledge of appropriate child-feeding practices, improving additional micronutrient-rich feeding during both pregnancy and lactation, educating and promoting mothers on appropriate infant and young child feeding, and specifically focusing on increasing child-feeding dietary diversity.

Abbreviations

AOR:	Adjusted odds ratio
DDS:	Dietary diversity score
EDHS:	Ethiopia Demography Health Survey
HAZ:	Height for age Z-score
IYCF:	Infant and young child feeding practice
LMICs:	Low- and middle-income countries
MAD:	Minimum acceptable diet
P:	p-value
SPSS:	Statistical Package for Social Science
SSA:	Sub-Saharan Africa
WHO:	World Health Organization
WASH:	Water, sanitation, and hygiene
UNICEF:	United Nations Children's Education Fund.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Additional Points

Study Limitations and Strength. This study identified very important risk factors associated with childhood stunting, including mothers' education, exclusive breastfeeding, and dietary diversity feeding, that could be preventable with simple health education and promotion interventions. This study was conducted among age groups that could have an opportunity to catch up later through appropriate intervention. The identified factors are vital to policy change in the health system for maternal and child health programs. The case–control nature of this study is stronger than a cross-sectional study in assessing determinates, which is important to develop a policy strategy to end or reduce stunting. This study has some limitations that need to be addressed by future researchers; it is not a matched case–control study, so it may increase bias. Mother's responses to independent variables may be subject to recall bias. All possible risk factors for stunting were not assessed, including infectious diseases, especially parasitic infections. Therefore, we recommended that further researchers address variables not assessed by this study with an advanced study design.

Disclosure

The funded agency did not take part in the study design, data collection, and manuscript preparation process.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Habtamu Tadesse was involved in the initiation of the research question, prepared the research proposal, carried out the research, did the data entry and analysis, and wrote the manuscript. Shelema Likassa conducted the edition, advising, cooperatively prepared research tools with PI, and revised the manuscript. Temkin Abdulah conducted the edition and reviewed the manuscript. Degu Getu and Samuel Abose did the data collection, prepared and reviewed the manuscript. All authors have read and approved the final manuscript.

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