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ORIGINAL RESEARCH

Assessment of Prevalence and Factors Associated with Malnutrition Among Under-Five Children in Debre Berhan Town, Ethiopia

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Background: Malnutrition is a deficiency or improper intake of energy and nutrients. It includes undernutrition (wasting, stunting, underweight, and mineral and vitamin-related malnutrition) and overnutrition.

Purpose: To estimate the prevalence and identify the risk factors for undernutrition among under-five children in Debre Berhan Town, North Shewa, Ethiopia.

Methods: A community-based cross-sectional study was conducted in Debre Berhan Town, from October 07, 2019 to January 24, 2020. Three hundred and eighty-five under-five children who were selected using systematic random sampling technique were included in this study. To collect data, a structured questionnaire and anthropometrical measurements were used. Data entry was done through Epi data 4.21, and for data analysis statistical package for social sciences version 20.0 was employed. Bivariate and multivariable logistic regression analysis was used to identify the factors associated with malnutrition. The statistical significance was stated at p value <0.05 with 95% confidence intervals.

Results: In the overall sample the total prevalence of undernutrition in below age-5 children was 61 (15.8%), the corresponding figures for underweight, stunted, and wasting were 26%, 41%, and 33%, respectively. Factors that contributed to under-five undernutrition were maternal illiteracy, not breastfeeding exclusively, preterm birth, absence of antenatal care, exposure to infectious diseases and diarrhea.

Conclusion: There was a higher prevalence of stunting (41%), wasting (33%), and being underweight (26%) in Debre Berhan town than the national (Ethiopia) or regional (Amhara) malnutrition prevalence. Mothers' educational status should be improved by teaching them that proper nutrition is important for their child's growth and development. Antenatal care for all pregnant women, education on child care, infection prevention, and child feeding should be provided and further strengthened.

Keywords: malnutrition, under nutrition, stunting, underweight, wasting, Debre Berhan

Introduction

Malnutrition is a deficiency or improper intake of energy and nutrients. It includes undernutrition (wasting, stunting, underweight, and micronutrient malnutrition) and overnutrition (obesity, some malignancies, and non-communicable illnesses).[1–4] Malnutrition results from the interaction between poor diet and diseases which leads to nutritional deficiencies observed among under-five children. Social, economic, biologic, and environmental factors are the underlying causes for the

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insufficient food intake or ingestion of food with proteins of low nutritional quality that leads to protein-energy malnutrition (PEM).[3,5]

Wasting is low weight for height. It indicates current weight loss, because a child consumes insufficient food or they are exposed to infectious diseases like diarrhea, which causes them to lose weight.[3,5] Stunting is low height for age. Stunting indicates children who are too short relative to their age. Stunting is the result of poor nutrition in early childhood which can last a lifetime.[3] Globally, about 149 million under-5 children are stunted, it results from chronic under-nutrition, typically related to poor socio-economic status, inappropriate maternal nourishment, recurrent illness, and/or improper child feeding and care in infancy.[3] Underweight is low weight for age and it includes stunting, wasting or both.[3,5]

Malnutrition is a prevalent problem affecting everyone at some time in their lifespan, but young children are at a greater risk of malnutrition. Optimizing nutrition from conception to two years of age, ensures the best possible start in life with long-term benefits.[1,3,6] Malnutrition results from a deficiency of good nutrition, caused by not having adequate food to eat, or not consuming enough of the right things. Many poor nutritional outcomes begin in the uterus and are manifested as LBW, prematurity, and intrauterine growth restriction.[1,2]

Malnourished children are at risk for infection and they are more prone to death due to common infantile respiratory and diarrheal disease. United Nations Decade of Action on Nutrition from 2016 to 2025 proclaimed to eliminate malnutrition and guarantee worldwide access to improved diets everywhere and for every (SDG2) and ensuring healthy lives for all ages.[7]

Despite these initiatives, malnutrition prevalence remains high; approximately half of all fatalities in under-5 children are due to undernutrition because undernutrition puts children at greater risk of dying from common infections, increases severity of infections, and delays recovery.[1,4,6] In 2019, worldwide, 21.3% of under-five children had stunted growth, 47 million under-five children were wasted, from this half of them were in South Asia and one out of four were in sub-Saharan Africa. From which nearly two out of five stunted children lived in South Asia while another two out of five lived in sub-Saharan Africa.[3,5] The impact of under-five malnutrition is the most serious problem for individuals, families, communities and for countries at large including, Ethiopia.

The result of the 2019 Ethiopian mini demographic health survey (EMDHS) indicated that even though the prevalence of malnutrition has decreased slowly in the last 10 years, under-five children still experience the highest rates of malnutrition, that is, 37% of them were stunted, 7% wasting, and 21% underweight.[8] The highest prevalence of stunting was observed in Tigray and Amhara accounting for 49% and 41% respectively, to a low 14% in Addis Ababa.[8] The highest prevalence of underweight children was observed in Somali and Afar regions (both at 32%), and 27% in Amhara. Rates of wasting among children were 21% in Somali, 14% in Afar, 7.6% in Amhara, and 2% in Addis Ababa.[8]

In this regard, from the nine regions and 2 city administrations (Addis Ababa and Dire Dawa) in Ethiopia, Amhara region is the second region where the prevalence of malnutrition is alarming. Since Debre Berhan town is found in Amhara region, a community-based nutritional study was needed to estimate the magnitude and identify the risk factors associated with under-five malnutrition in this study area.

In addition, in spite of few studies done at national and regional levels, the prevalence and risk factors in Debre Berhan Town have been inadequately emphasized, which results in difficulty in providing community based nutritional interventions. Even the national and regional data are not generally a reflection of the local estimate of child malnutrition. These openings demand the need for this study. Therefore, this study was conducted aimed at assessing the prevalence and identifying the risk factors of malnutrition (stunting, wasting, and underweight) among children less than 5 years in Debre Berhan town.

Methods and Materials

Study Design, Setting, and Eligibility Criteria

A community-based cross-sectional study was employed from 07/10/2019 to 24/01/2020 in Debre Berhan Town, which is found in North Shewa of Amhara region 130 km away from Addis Ababa, with four governmental and twelve private health institutions. All sampled/selected children of age 0–59 months who were available during the data collection period were included in this study, but under-5 children who were not available during the data collection period were considered as "non-response" after two revisits.

Sampling Technique and Sample Size Determination

Systematic random sampling technique was used. The sample size was determined by using 95% CI and a proportion of 0.5, with an alpha 0.05 and power 0.80, the sample size needed N=384. 10% non-response rate was added, so 384+10% of 384= 422 malnourished children were candidates for this study, but only 385 (91.2%) of them were assessed for height, weight, and age to ascertain the nutritional status based on the three indicators of malnutrition. So, the final sample size for analysis was 385 under-five children.

Study Variables

Dependent Variable

Under-five child malnutrition status (stunting, wasting, and underweight).

Independent Variables

Socio-demographic characteristics of the mother: religion, ethnicity, educational level, occupation, and family income level.

Food, water, and sanitation service of the household: HH food source, the source of drinking water for HH, water treatment practice, kind of toilet facility, household waste disposal, and hand washing practice before feeding children or any activity.

Maternal health conditions and antenatal follow-up behavior: physiological status of the mother, ANC follow up, eating habits during pregnancy, and BMI of the mother.

Child feeding practice and vaccination status of children: child breastfeeding, how long after birth did the child breastfeed for the 1st time, feeding practice for the first 6 months of the child's life, how long was the baby breastfed, vaccination status, and complementary feeding starting time.

Child assessments and health conditions: MUAC at current state, sex, age in months, maturity, exposed to infectious disease and exposure to diarrhea.

Operational Definitions

Diarrheal disease: the passage of loose or watery stools at least three times in a 24h period.

Wasting: the weight-for-height z score >−3 SD in relation to the reference population.[9]

Stunting: the height-for-age-z-score<−2 SD in relation to the reference population.[9]

Underweight: the weight-for-age-z-score<−2 SD relative to the reference population.[9]

Exclusive breastfeeding (EBF). Feeding a child breast milk only for the first 6 months of life, except medicines.

Complementary feeding: supplementation of breastfeeding with other soft, semi-solid or solid foods to meet the nutritional requirements of children.

Measurements

The dependent variable for this study was the malnutrition status of under-5-year-old children (stunting, underweight, and wasting).

The weight and height of children were measured using the standard anthropometric measurement protocol designed by the Food and Nutrition Technical Assistance project in 2007.[10] Weight was measured using a weighing scale without coats, shoes, and any additional clothing and recorded to the nearest 0.1 kg.

Height was taken by using studio meter with no shoes; for 6–23 months of age length was taken and for 24–59 months of age height to the nearest 0.1 cm was recorded.

MUAC was measured in the middle of shoulder tip and elbow tip through vertical axis of the upper arm with the arm positioned at right angle.[10,11] Age was recorded from the card, the mother or care giver and also at the time of vaccination. The weight, height, and age of child (months) were changed to height-for-age, weight-for-age, and weight-for-height by using WHO Anthro 3.2.1 software.[12]

Anthropometric classifications were used based on global standards: <−3 SD, <−2 SD, and ≥−2 SD.[12] Children with HAZ, WAZ, and WHZ below −2 SD of the median of reference population were considered as stunted, underweight, and wasted, respectively.[13] A minimum of 1 index from HAZ, WAZ, and WHZ below −2 SD was enough to categorize as malnourished or not malnourished (1 for malnourished, and 0 for not malnourished). Stunting, underweight, and wasting were measured as the dependent variables in the logistic analysis. The dichotomous variables for stunting, underweight, and wasting were defined as 1 for stunted and 0 for not stunted, 1 for underweight and 0 for not underweight, and 1 for wasted and 0 for not wasted, respectively.

The immunization status of children was assessed by asking the mothers, observing scar, and checking the immunization card.

Data Collection Tool and Procedure

The tool was adapted from Ethiopian Demographic and Health Survey (EDHS),[13,14] and other related literature. To collect data, the questionnaire was translated into

Amharic; the questionnaire was validated by experts and pretested before starting the actual data collection. For data collection, an interviewer-administered questionnaire was employed and the survey consisted of socio-demographic characteristics of the mother, food, water, and sanitation service of the household, maternal health conditions and antenatal follow-up behavior, child feeding practice, vaccination status of children, and children's assessments and health conditions. Six BSc nurses and principal investigator were involved in the data collection process. Before the actual work, training and orientation were given for data collectors. Before interview the objective of the study was explained to study participants and it was granted that the information will be kept confidential; then a verbal informed consent was obtained from mothers or caregivers.

The data were collected from each caregiver or parent during the interview. The investigator guided the data collection process, correctness, and completeness of the questionnaire. The English version of the questionnaire was translated to the Amharic version and back-translated to English to check for its consistency.

Data Processing and Analysis

The data were coded, entered, edited, and cleaned using Epi-data version 4.21 and analyzed in SPSS version 20. Descriptive and inferential analysis was done as applicable. Descriptive analysis using percent and frequency was calculated for the 4 anthropometric indicators, weight for age, weight for height, height for age, and MUAC. The result of the data was presented by using frequency distribution, graph, and chart.

Bivariable and multivariable logistic regression were used to identify the risk factors related to malnutrition. Independent variables (with p value at <0.20) that were used to adjust the OR in logistic regression were maternal/caretaker educational level, family income level, age of the child, maternal BMI, exclusive breast-feeding practice, diarrhea exposure in the last two weeks, exposure to infectious diseases, HH water treatment practice, 1st breastfed time, antenatal care, preterm, caretaker hand washing practice, and vaccination status.

In the final multivariable logistic analysis, maternal/caretaker educational level, exclusive breast-feeding practice, diarrhea exposure, antenatal care, preterm, caretaker hand washing practice, and vaccination status were significantly associated (p value at <0.05 with 95% CI) with the risk of malnutrition (Tables 6–8).

This model had an overall predictive capacity of 89.3 which is greater than the null's predictive ability (76.3%), ie, about 89% of the outcome variable was correctly predicted or classified by the model employed. To test for model fitness, the Hosmer–Lemeshow was done and it was 0.94. It tests how good the model was and p was insignificant (>0.05), thus, the model was good. The Nagelkerke R Square test indicates how much of the outcome variable is explained by predictor variables, and in this case about 59% of the outcome variable was explained by the predictors, which is good.

Results

Socio-Demographic Characteristics of the Mother

Among mothers assessed from the current study, the majority of the respondents were Orthodox Christian followers, 286 (74.2%), followed by Muslim, 65 (16.9%), Protestant, 23 (6%), and others, 11 (2.9%). Concerning the educational status of mothers, this study revealed that about 75 (19.5%) of mothers could not read or write, 49 (12.7%) were informally educated, 110 (28.6%) had primary level, 108 (28%) had secondary level, and 43 (11.2%) of them had high level of education (Table 1).

Food, Water, and Sanitation Service of the Household

Among 385 respondents who were asked what their main food source was, the majority of them got their food by purchasing, 198 (51.4%), followed by own production and purchasing, 97 (25.2%), own production, 79 (20.5%), and from food aid, 11 (2.9%). Regarding the source of drinking water for the household, this study revealed that about 6 (1.6%) of them used water piped to dwelling, 12 (3.1%) used spring water, 22 (5.7%) used tube well, 18 (4.7%) used tanker truck. This study indicated that about 220 (57.1%) mothers or caretakers always washed their hands before feeding their child, 156 (40.5%) washed sometimes, whereas 9 (2.4) did not wash their hands before feeding their child (Table 2).

Maternal Health Conditions and Antenatal Follow-Up Behavior

This study indicated that two hundred and sixty-nine (69.9%) mothers had a complete antenatal follow up, 76 (19.7) of them had incomplete ANC follow up, and 40 (10.4) of them did not have a follow-up at all.

Table 1 Frequency Distribution of Socio-Demographic Characteristics of the Mothers in Debre Berhan Town, North Shewa Zone, Ethiopia, 2019 (N=385)

Variables	Category	Malnourished		Row Total	
		Yes(%)	No(%)	Count	Frequency (%)
Religion	Orthodox	43 (15)	243 (85)	286	74.2
	Muslim	12 (18.5)	53 (81.5)	65	16.9
	Protestant	4 (17.4)	19 (82.6)	23	6
	Others	2 (18)	9 (82)	11	2.9
Ethnicity	Amhara	40 (19.4)	166 (80.6)	206	53.6
	Oromo	16 (19)	68 (91)	84	21.8
	Tigre	3 (12.5)	21 (87.5)	24	6.2
	Others	2 (2.8)	69 (97.2)	71	18.4
Educational level	Cannot read or write	26 (37.3)	49 (62.3)	75	19.5
	Informal education	10 (20.4)	39 (79.6)	49	12.7
	1–8	11 (10)	99 (89)	110	28.6
	9–12	10 (9.3)	98 (92.6)	108	28
	College/university or vocational	4 (9.3)	39 (93.1)	43	11.2
Occupation	Government employee	13 (13.8)	81 (86.2)	94	24.4
	Housewife	20 (13)	135 (87)	155	40.3
	Merchant	13 (17.8)	60 (82.2)	73	19
	Daily laborer	15 (23)	48 (77)	63	16.3
Family income level	Less than 3000 ETB	23 (23.7)	74 (76.3)	97	25.2
	3000–7000 ETB	25 (14)	155 (86)	180	46.7
	>7000 ETB	13 (12)	95 (88)	108	28.1

Abbreviation: ETB, Ethiopian birr.

Regarding body mass index of the mothers, about 210 (54.5%) of them were below a BMI of 20 kg/m2, and 175 (45.5%) of them were above a BMI of 20 kg/m2 (Table 3).

Child Feeding Practice and Vaccination Status of Children

From 385 children, about 349 (90.6%) were breastfed, but 36 (9.4%) of them did not breastfeed. In this study, about 246 (63.9%) were breastfed exclusively for the first 6 months, and the rest, 139 (36.1%), of them were not exclusively breastfed. Pertaining to vaccination, 180 (46.6%) completed their vaccines, about 125 (32.5%) had not completed their vaccines, and the rest, 80 (20.9%), did not take the vaccine at all (Table 4).

Complementary Feeding Starting Time

From 385 children, 83 (21.6%) of them started supplementary feeding before 6 months, 208 (54%) of them started at 6 months, and 94 (24.4%) started supplementary feeding after 6 months (Figure 1).

Children's Assessments and Health Conditions

From 385 children assessed, 192 (49.9%) were male and 193 (50.1%) were female. MUAC assessment showed that about 118 (30.6%) were below 11cm, 94 (24.4%) between 11cm and 12 cm, 81 (21.1) between 12–13.5 cm, and 92 (23.9%) above 13.5 cm. About 211 (54.8%) were exposed to diarrhea, and 174 (45.2%) of them were not exposed (Table 5).

Prevalence of Malnutrition (Wasting, Stunting, and Underweight)

Of the overall sample of 422 children, 385 (91.2%) of them were included and measured for their height and weight to ascertain the nutritional status based on the three indicators of WFH, HFA, and WFA, the results showed that 16 (26%), 25 (41%), 20 (33%) were underweight, stunted, and wasted respectively. The overall prevalence of malnutrition among under-5 children was found to be 61 (15.8%), and well-nourished 324 (84.2%) (Figure 2).

Table 2 Food, Water and Sanitation Service of the Household in Debre Berhan Town, North Shewa Zone, Ethiopia, 2019 (N=385)

Variables	Category	Malnourished		Row Total	
		Yes(%)	No(%)	Count	Frequency %)
Main food source	Own production	12 (15.2)	67 (84.8)	79	20.5
	Purchase	34 (17.2)	164 (82.8)	198	51.4
	Own production and purchase	13 (13.4)	84 (86.6)	97	25.2
	Food aid	2 (18.2)	9 (81.8)	11	2.9
The main source of drinking water for house hold	Piped to dweling	2 (33.3)	4 (66.7)	6	1.6
	Public tap	41 (12.5)	286 (87.5)	327	84.9
	Tube well	7 (31.8)	15 (68.2)	22	5.7
	Tanker truck	7 (38.9)	11 (61.1)	18	4.7
	Springwater	4 (33.3)	8 (66.7)	12	3.1
Water treatment practice	Yes, always	4 (6.6)	57 (93.4)	61	15.8
	Yes, sometimes	14 (15.1)	79 (84.9)	93	24.2
	No	43 (18.6)	188 (81.4)	231	60
Water treatment to make it safer to drink (N=154)	Boil	5 (10)	45 (90)	50	32.5
	Add chlorine	11 (12.2)	79 (87.8)	90	58.4
	Other	2 (14.3)	12 (85.7)	14	9.1
Kind of toilet facility	Pour flush to a piped sewer system	23 (15.8)	123 (84.2)	146	37.9
	Flush pit latrine	28 (16.6)	141 (83.4)	169	43.9
	VIPL ventilated improved pit latrine	3 (15)	17 (85)	20	5.2
	Bush/field	7 (14)	43 (86)	50	13
Household waste disposal	Collected by municipality	23 (19.2)	97 (80.8)	120	31.2
	Buried	8 (15.4)	44 (84.6)	52	13.5
	Dump in the street open	8 (10.4)	69 (89.6)	77	20
	Dispose of in the compound	7 (15.2)	39 (84.8)	46	11.9
	Burned	15 (16.7)	75 (83.3)	90	23.4)
Hand washing before feeding children or any activity	Yes, always	29 (13.2)	191 (86.8)	220	57.1
	Yes, sometimes	30 (19.2)	126 (80.8)	156	40.5
	No	2 (22.2)	7 (77.8)	9	2.4

Factors Associated with Under-Five Malnutrition

Factors Associated with Stunting

The bivariate logistic regression revealed maternal/caretaker educational level, family income level, age of the child, maternal BMI, exclusive breast-feeding practice, diarrhea exposure in the last two weeks, and exposure to infectious diseases were associated with stunting. However, educational level (AOR=4, 95% CI: 2.1–2-11.4), (AOR=4, 95% CI: 1.8–16), child's age ((AOR=3.2, 95% CI: 1.4–8.7), EBF (AOR=2.3, 95% CI: 1.4–5.6), and diarrheal exposure (AOR=1.9, 95% CI: 1.2–3.5)) were independent predictors of stunting (Table 6). Therefore, children born from families who cannot read or write, and informally educated family were 4 times more likely to be stunted as compared to children born from university or college educated families (AOR=4, 95% CI: 2.1–2-11.4, and AOR=4, 95% CI: 1.8–16) respectively. This study also revealed that 24–59 month old children were 3.2 times more likely to be stunted than 0–6 month aged children (AOR=3.2, 95% CI: 1.4–8.7). Not exclusively breast-fed children were 2.3 times more likely to develop stunting than exclusively breastfed children (AOR=2.3, 95% CI: 1.4–5.6), and diarrhea exposed children were 1.9 times more likely to be stunted than non-exposed children (AOR=1.9, 95% CI: 1.2–3.5) (Table 6).

Factors Associated with Wasting

Maternal/caretaker educational level, HH water treatment practice, antenatal care, 1st breastfed time, preterm, exclusive breast-feeding practice, diarrheal exposure, and exposure to infectious diseases were associated with wasting in the bivariate logistic regression.

Table 3 Maternal Health Conditions and Antenatal Follow Up in Debre Berhan Town, North Shewa Zone, Ethiopia, 2019 (N=385)

Variables	Category	Malnourished		Row Total	
		Yes(%)	No(%)	Count	Frequency(%)
Physiological status of the mother	Pregnant	8 (14.5)	47 (85.5)	55	14.3
	Lactating	27 (14.4)	161 (85.6)	188	48.8
	Nonpregnant	7 (19.4)	29 (80.6)	36	9.4
	Non-lactating	19 (17.9)	87 (82.1)	106	27.5
ANC follow up	Complete	25 (9.3)	244 (90.7)	269	69.9
	Incomplete	23 (30.3)	53 (69.7)	76	19.7
	None	13 (32.5)	27 (67.5)	40	10.4
As part of ANC, do you get maternal nutritional information (N=345)	Yes	20 (12)	140 (8)	166	48.1
	No	28 (15.6)	151 (84.4)	179	51.9
Malaria drug given (N=345)	Yes	30 (10.7)	250 (89.3)	280	81.2
	No	18 (27.6)	47 (72.3)	65	18.8
Did you get iron folate during pregnancy (N=345)	Yes	23 (10.4)	199 (89.6)	222	64.3
	No	25 (20.3)	98 (79.7)	123	35.7
Did you take deworming tablet during your last pregnancy (N=345)	Yes	22 (11)	178 (89)	200	58
	No	26 (17.9)	119 (82.1)	145	42
Eating habits during pregnancy	Less than usual	23 (20.4)	90 (79.6)	113	29.4
	Same as usual	19 (15.8)	101 (84.2)	120	31.1
	More than usual	19 (12.5)	133 (87.5)	152	39.5
BMI of the mother	<20 kg/m2	43 (20.5)	167 (79.5)	210	54.5
	>20 kg/m2	18 (10.3)	157 (89.7)	175	45.5

Abbreviations: ANC, antenatal care; BMI, body mass index.

Though, educational level (AOR=2, 95% CI: 1.01–10.3), ANC (AOR=3, 95% CI: 1.9–5.3), (AOR=2.5, 95% CI: 1.4–9.7), EBF (AOR=2.5, 95% CI: 1.3–12), diarrheal exposure (AOR=2, 95% CI: 1.1–3.6), and being preterm (AOR=3.7, 95% CI: 3.1–13.2) were independent predictors for child wasting (Table 7).

Therefore, children born from families who cannot read or write had 2 times more risk to develop wasting than children born from university or college educated families (AOR=2, 95% CI: 1.01–10.3). It was also observed children born from mothers who had incomplete maternal ANC follow-up and those who did not have ANC follow-up at all were 3 and 2.5 times more likely to be wasted than children from mothers who had complete ANC follow-up (AOR=3, 95% CI: 1.9–5.3), and (AOR=2.5, 95% CI: 1.4–9.7) respectively. Preterm children were 3.7 times more likely to be wasted than term children (AOR=3.7, 95% CI: 3.1–13.2), not exclusively breast-fed children were 2.5 times more likely to be wasted than exclusively breastfed children (AOR=2.5, 95% CI: 1.3–12), and diarrhea exposed children were 2 times more likely to be wasted than non-exposed children (AOR=2, 95% CI: 1.1–3.6) (Table 7).

Factors Associated with Underweight

In the bivariate logistic regression, maternal/caretaker educational level, antenatal care, caretaker hand washing practice, age of the child, vaccination status, 1st breastfed time, preterm, exclusive breast-feeding practice, diarrheal exposure, and exposure to infectious diseases were associated with being underweight. However, educational level (AOR=2.5, 95% CI: 1.7–14), ANC (AOR=2.5, 95% CI: 1.5–7.6), (AOR=3, 95% CI: 1.3–9), EBF (AOR=2, 95% CI: 1.24–6.7), hand washing before feeding children (AOR=2, 95% CI: 1.3–8.5), vaccination status (AOR=2, 95% CI: 1.3–6.4), and being preterm (AOR=1.8, 95% CI: 1.03–2.5) were independent predictors for child being underweight in multivariable logistic regression (Table 8).

Therefore, children born from families who cannot read or write had 2.5 times higher risk of being underweight as compared to children born from university or college educated families (AOR=2, 95% CI: 1.01–10.3). Children born from mothers with incomplete maternal

Table 4 Feeding Practice and Vaccination Status of the Child in Debre Berhan Town, North Shewa Zone, Ethiopia, 2019

Variables	Category	Malnourished		Row Total	
		Yes(%)	No(%)	Count	Frequency (%)
Was the child breastfed	Yes	50 (14.3)	299 (85.7)	349	90.6
	No	11 (30.5)	25 (69.5)	36	9.4
If no, why not (N=36)	Mother ill	4 (28.6)	10 (71.4)	14	8.9
	Child ill	4 (33.3)	8 (66.7)	12	3.3
	Insufficient milk	3 (30)	7 (70)	10	7.8
How long after birth did the child breastfeed for the 1st time?	Immediately	16 (10.4)	138 (89.6)	154	40
	After one hour	28 (17.2)	135 (82.8)	163	42.3
	After one day	17 (25)	51 (75)	68	17.7
Feeding practice for the first 6 months of a child's life	Breast milk only/EBF	22 (9)	224 (91)	246	63.9
	Infant formula	13 (26)	37 (74)	50	13
	Breast milk and formula milk	21 (30)	49 (70)	70	18.2
	Other	5 (26.3)	14 (73.7)	19	4.9
How long did the baby breastfeed	< 1 year	23 (27.7)	60 (72.3)	83	21.6
	1–2 years	27 (13.2)	178 (86.8)	205	53.2
	>2 years	11 (11.3)	86 (88.7)	97	25.2
Vaccination	Complete	15 (8.3)	165 (91.7)	180	46.6
	Incomplete	26 (20.8)	99 (79.2)	125	32.5
	None	20 (25)	60 (75)	80	20.9

Abbreviation: EBF, exclusive beast feeding.

ANC follow-up, and those who did not have ANC follow-up at all were 2.5 and 3 times more likely to be underweight than children born from mothers who had complete ANC follow-up (AOR=3, 95% CI: 1.9–5.3), and (AOR=2.5, 95% CI: 1.4–9.7) respectively. Preterm children were 1.8 times more likely to be underweight than term children (AOR=1.8, 95% CI: 1.03–2.5), not exclusively breast-fed children were 2 times more likely to be underweight than exclusively breast-fed children (AOR=2, 95% CI: 1.24–6.7). Children born from mothers who did not wash their hands before feeding the child were 2 times more likely to be underweight than children from mothers who always washed their hands before feeding the child (AOR=2, 95% CI: 1.3–8.5), and children who

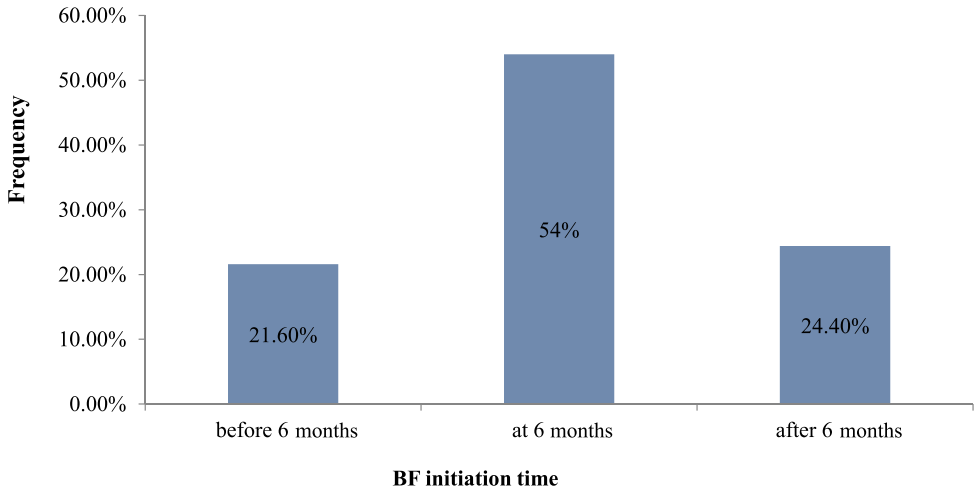

Figure 1 Children's complementary feeding starting time in Debre Berhan Town, North Shewa zone, Ethiopia, 2019.

Table 5 Children's Assessments and Health Conditions of Children with Malnutrition Status in Debre Berhan Town, North Shewa Zone, Ethiopia, 2019 (N=385)

Variables Category		Malnourished		Row Total	
		Yes (%)	No (%)	Count	Frequency (%)
MUAC	<11 cm 11–12 cm 12CM-13.5 >13.5CM	20 (17) 16 (17) 17 (21) 8 (8.7)	98 (83) 78 (83) 64 (79) 84 (91.3)	118 94 81 92	30.6 24.4 21.1 23.9
Sex	Male Female	31 (16) 30 (15.5)	161 (84) 163 (84.5)	192 193	49.9 50.1
Age in months	0–6 6–12 12–24 24–59	24 (10) 11 (19.6) 12 (26) 14 (31)	214 (90) 45 (80.4) 34 (74) 31 (69)	238 56 46 45	61.8 14.5 11.9 11.8
Was the child weighed at birth	Yes No Do not know	27 (15.6) 23 (17.7) 11 (13.4)	146 (84.4) 107 (82.3) 71 (86.6)	173 130 82	44.9 33.8 21.3
If yes for the above, how much did it weigh (N=173)	Less than 2.5 2.5–3.9 >4kg	15 (22.4) 6 (9.4) 6 (15.8)	52 (77.6) 62 (80.6) 32 (84.2)	67 68 38	38.7 39.3 22
Preterm	Yes No	27 (23) 34 (12.7)	90 (77) 234 (87.3)	117 268	30.4 69.6
Exposed to infectious disease	Yes No	27 (24.3) 34 (12.4)	84 (75.7) 240 (87.6)	111 274	28.8 71.2
Exposure to diarrhea	Yes No	46 (21.8) 15 (8.6)	165 (78.2) 159 (91.4)	211 174	54.8 45.2

Abbreviations: MUAC, mid upper arm circumference; CM, centimeter.

were not vaccinated were 2 times more likely to be underweight than vaccinated children (AOR=2, 95% CI: 1.3–6.4) (Table 8).

Discussion

To successfully tackle under-five malnutrition, the magnitude has to be estimated and the factors influencing malnutrition should be explored. This study aimed at assessing the prevalence and factors associated with under-five malnutrition (stunting, wasting, and underweight) in Debre Berhan town, North Shewa zone, Amhara regional state, Ethiopia.

Prevalence of Malnutrition (Stunting, Wasting, and Underweight)

The current study revealed that the overall prevalence of malnutrition among under-5 children was found to be 15.8%, and the corresponding figures of stunting, wasting, and underweight were 41%, 33%, and 26% respectively.

Prevalence of Stunting

In this study, the magnitude of stunting was higher than the overall prevalence of stunting, 21.9%, Nepal 36%, Lesotho 33.4%, and Botswana 38.7%.[3] The reason for the higher prevalence of stunting in Ethiopia could be due to the fact that Ethiopia is a low-income country, but Latin America and Caribbean countries, Nepal, Botswana and Lesotho are middle income countries.[15] Due to these socio-economic inequalities, the food diversity and availability (quality and quantity) as well as access to quality health care service of Ethiopia might not be good as compared to the middle-income countries.

The prevalence of stunting was lower than in Asia 55%,[5] Malawi[3] 50%,[4] India 43%,[16] Nigeria 47.6%.[17] The possible explanation for the lower prevalence of stunting in Ethiopia as compared to Malawi might be due to the

Table 6 Bivariable and Multi Variable Regression for Factors Associated with Stunting Among Under-Five Children in Debre Berhan Town, North Shewa Zone, Ethiopia, 2020 (N=385)

Variables	Category	Stunting		COR [95% CI]	AOR [95% CI]
		Yes (%)	N (%)		
Educational level	Cannot read or write Informal education 1–8 9–12 College/university or vocational	9 (12) 6 (12) 5 (4.5) 4 (3.7) 1 (2.3)	66 (88) 43 (88) 105 (85.5) 104 (96.3) 42 (97.7)	6 (3.3–19) 6 (3–13) 2 (0.9–6) 1.5 (0.3–4) 1	4 (2.1–11.4)* 4 (1.8–16)* 1.2 (0.3–7) 0.9 (0.22–4.7) 1
Child's Age (mths)	0–6 6–12 12–24 24–59	9 (3.8) 4 (7.1) 5 (11) 7 (15.6)	229 (96.2) 52 (92.9) 41 (89) 38 (84.4)	1 2 (0.9–4.8) 3 (1.4–6.9) 4.7 (2–8.6)	1 1.1 (0.8–10) 1.5 (0.8–9.2) 3.2 (1.4–8.7)*
Family income level	Less than 3000 ETB 3000–7000 ETB >7000 ETB	11 (11.3) 8 (4.4) 6 (3.6)	86 (88.7) 172 (95.6) 102 (94.4)	2.2 (1.2–11) 0.7 (0.3–3.8) 1	1.3 (0.96–9) 0.6 (0.3–4.3) 1
Maternal BMI	<20 kg/m2 >20 kg/m2	15 (7.1) 10 (5.7)	195 (92.9) 165 (94.3)	1.3 (0.8–4.9) 1	0.8 (0.4–2.7) 1
EBF practice	Yes No	9 (3.7) 16 (11.5)	237 (96.3) 123 (88.5)	1 3.5 (1.9–6)	1 2.3 (1.4–5.6)*
Exposure to diarrheal disease	Yes No	19 (9) 6 (3.4)	192 (91) 168 (96.6)	3 (1.3–4.4) 1	1.9 (1.2–3.5* 1
Exposed to infectious diseases	Yes No	11 (10) 14 (5)	100 (90) 260 (95)	2 (1.2–3.7) 1	1.5 (0.9–4) 1

Note: *Significant at $p < 0.05$.
Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

higher gross national income of Ethiopia (Ethiopia's GNI per capita for 2019 was $850, but Malawi's GNI per capita for 2019 was $380).[15] So, this could be the reason for the variation. In spite of India's middle-income economy, the prevalence of stunting in Ethiopia is less than in India. This could be due to short maternal stature contributing to a high prevalence of stunting in India relative to Ethiopia.[18]

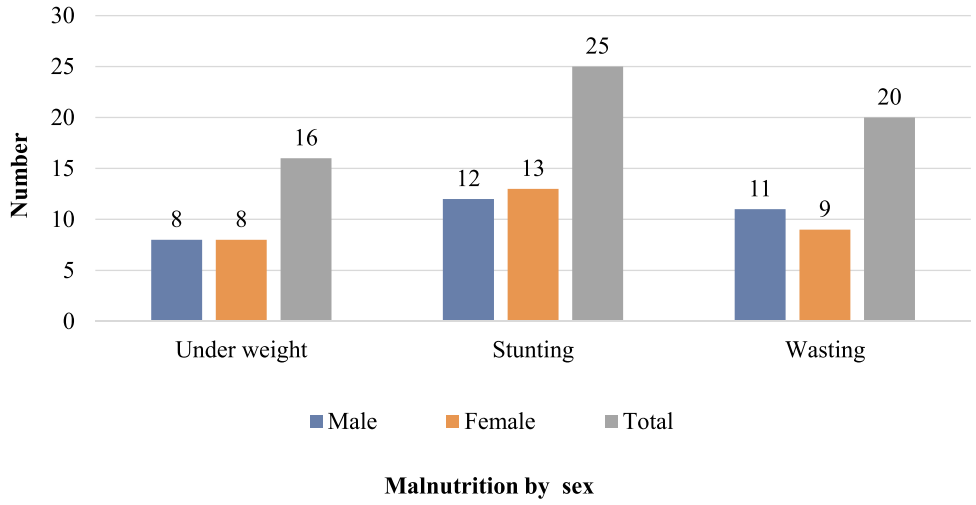

Figure 2 Prevalence of wasting, stunting, and underweight by sex in Debre Berhan Town, North Shewa, Ethiopia, 2019.

Table 7 Bivariable and Multi Variable Regression for Factors Associated with Wasting Among Under-five Children in Debre Berhan Town, North Shewa Zone, Ethiopia, 2020 (N=385)

Variables	Category	Wasting		COR [95% CI]	AOR [95% CI]
		Yes(%)	No(%)		
Educational level	Cannot read or write	10 (13.3)	65 (86.7)	3.2 (1.1–18)	2 (1.01–10.3)*
	Informal education	2 (4.1)	47 (95.9)	0.9 (0.4–8)	0.4 (0.3–6.4)
	1–8	3 (2.7)	107 (97.3)	0.6 (0.2–6.5)	0.3 (0.1–4)
	9–12	3 (2.8)	105 (97.2)	0.6 (0.3–4.9)	0.4 (0.2–5.9)
	College/university or vocational	2 (4.6)	41 (93.1)	1	1
EBF practice	Yes	7 (2.8)	239 (97.2)	1	1
	No	13 (9.4)	126 (90.6)	3.5 (1.9–6)	2.5 (1.3–12)*
Water treatment practice	Yes, always	2 (3.3)	59 (96.7)	1	1
	Yes, sometimes	4 (4.3)	89 (95.7)	1.3 (0.7–3.6)	1 (0.8–11)
	No	14 (6)	217 (94)	1.9 (1.3–4.7)	1.5 (0.98–6)
1st breastfeeding time	Immediately after birth	5 (3.2)	149 (96.8)	1	1
	After one hour	10 (6.1)	153 (93.9)	1.8 (0.9–6)	1.5 (0.6–4.1)
	After one day	5 (7.4)	63 (92.6)	2.2 (1.4–6.1)	2 (1–8.7)
ANC	Complete	8 (3)	261 (97)	1	1
	Incomplete	8 (10.5)	68 (89.5)	4 (2.2–8.1)	3 (1.9–5.3)*
	None	4 (10)	36 (90)	3.6 (2–10)	2.5 (1.4–9.7)*
Exposure to diarrheal disease	Yes	15 (7.1)	196 (92.9)	2.7 (1.3–4.4)	2 (1.1–3.6)*
	No	5 (2.8)	169 (97.8)	1	1
Preterm	Yes	16 (13.7)	101 (86.3)	9 (4.4–17)	3.7 (3.1–13.2)*
	No	4 (1.5)	264 (98.5)	1	1
Exposed to infectious diseases	Yes	9 (8.1)	102 (91.9)	2 (1.2–3.7)	1.4 (1–3.2)
	No	11 (4)	263 (96)	1	1

Note: *Significant at $p < 0.05$.

Prevalence of Wasting

In this study the prevalence of wasting was higher than in India, 10.5%,[16] Shire Indeseallsaie, North Ethiopia 4.1%,[19] Afar 16.2%,[20] Gondar7.3%,[21] Haramaya District, Ethiopia, 14.4%,[22] Kemissie special zone, southwest Amhara 12.6%,[23] Hidabu Abote District, Oromia region 16.7%,[24] Bure Town 11.1%,[25] Bule Hora district, South Ethiopia 13.4%,[4] Tigray region 10.6%,[26] and 2019 EMDHS 7%.[8] The reason for this variation might be due to difference in the quality and access to the health care system of the study area, socioeconomic inequality among countries or between regions, study subject, and study period. As Ethiopia is a diversified nation, in different parts of Ethiopia there might be different feeding behavior which could result in increase or decrease in malnutrition prevalence. So, the higher prevalence of wasting in this study area (Debre Berhan) as compared to other areas of Ethiopia could be explained in this context. The prevalence of wasting in Debre Berhan was lower than in Asia 68%,[5] Botswana 47%,[3] Dollo Ado district, Somali region, Ethiopia 42.3%.[27] This is due to differences in the health care system of the study area, and socioeconomic status of countries.

Prevalence of Being Underweight

In this study the prevalence of being underweight was higher than in Botswana 15.6%,[3] Bangladeshi 24.5%,[28] Shire Indeseallsaie, North Ethiopia 20.9%,[19] Afar 24.8%,[20] Addis Ababa,[8] and 2019 EMDHS 21%,[8] but lower than in Pakistan 33.3%,[29] Somali and Afar regions 32%,[8] and almost in line with a study done in Nigeria 25.6%.[17] This variation could be due to study setting difference, design employed, and sample size taken.

Among the socio-demographic characteristics of the households, maternal educational status was significantly associated with stunting, wasting, and underweight.

Table 8 Bivariable and Multivariable Regression for Factors Associated with Being Underweight Among Under-five Children in Debre Berhan Town, North Shewa Zone, Ethiopia, 2020 (N=385)

Variables	Category	Underweight		COR [95% CI]	AOR [95% CI]
		Yes (%)	No (%)		
Educational level	Cannot read or write Informal education 1–8 9–12 College/university or vocational	7 (9.3) 2 (4.1) 3 (2.7) 3 (2.7) 1 (2.3)	68 (90.7) 47 (95.9) 107 (97.3) 105 (97.3) 42 (97.7)	4.3 (2.2–28) 1.8 (1.2–8.9) 1.2 (0.4–6) 1.2 (0.3–4) 1	2.5 (1.7–14)* 1.3 (0.9–6) 0.9 (0.2–8.9) 0.8 (0.4–7.4) 1
Child's Age (mths)	0–6 6–12 12–24 24–59	7 (2.9) 2 (3.6) 3 (6.5) 4 (9)	231 (97.1) 54 (96.4) 43 (93.5) 41 (91)	1 1.2 (0.6–3.8) 2.2 (1.2–5.9) 3.2 (1.6–8.6)	1 0.9 (0.4–2.2) 1.6 (1.3–7.3)* 2.5 (1.9–12)*
EBF practice	Yes No	6 (2.4) 10 (7.2)	240 (97.6) 129 (92.8)	1 3 (1.5–6.3)	1 2 (1.24–6.7)*
Hand washing before feeding children or any activity	Yes, always Yes, sometimes No	8 (3.6) 7 (4.5) 1 (11.1)	212 (96.4) 149 (95.5) 8 (88.9)	1 1.2 (0.6–7) 3.3 (1.7–10)	1 0.8 (0.76–4.9) 2 (1.3–8.5)*
ANC	Complete Incomplete None	6 (2.2) 6 (7.9) 4 (10)	263 (97.8) 70 (92.1) 36 (90)	1 3.8 (2–8.1) 4.7 (2–10)	1 2.5 (1.5–7.6)* 3 (1.3–9)*
Vaccination	Complete Incomplete None	4 (2.2) 7 (5.6) 5 (6.3)	176 (97.8) 118 (94.4) 75 (93.7)	1 2.4 (1.3–6.3) 3 (1.8–8)	1 1.7 (1–4.2) 2 (1.3–6.4)*
Exposure to diarrheal disease	Yes No	12 (5.7) 4 (2)	199 (94.3) 170 (98)	2.6 (1.1–4.4) 1	1.8 (0.9–3.8) 1
Preterm	Yes No	7 (6) 9 (3)	110 (94) 259 (87.3)	2.3 (1.6–3.6) 1	1.8 (1.03–2.5)* 1
Exposed to infectious diseases	Yes No	7 (6.3) 9 (3.3)	104 (93.7) 265 (96.7)	2 (1.2–3.7) 1	1.6 (0.9–4.6) 1

Note: *Significant at $p < 0.05$.

Children born from families who could not read or write, and informally educated families had 4.2 and 2.5-times higher risk to develop stunting, wasting and underweight, respectively as compared to children born from university or college educated families. This could be explained by the fact that education could make a difference by empowering mothers to make decisions on the type of or use of preventive medicine. Promoting health nutrition education could also help the mother to make informed nutritional decisions about certain types of food for their children. Not knowing the importance of nutrients can lead to malnutrition as the individual will not have a healthy, balanced diet. This finding was consistent with studies conducted in Karat Town, Southern Ethiopia,[30] Machakel Woreda, Northwest Ethiopia,[31] Gondar, northwest Ethiopia,[21] Shire indeseallsaie, Northern Ethiopia,[19] Bule Hora, South Ethiopia,[4] Dollo Ado, Somali region, Ethiopia,[27] and Afar, Ethiopia.[20]

In the current study, exclusive breast-feeding practice had a significant association with stunting, wasting and underweight. Not exclusively breast-fed children had 2.3, 2.5, and 2-times higher risk to be stunted, wasted and underweight respectively than exclusively breast-fed children. This is because exclusive breastfeeding provides all nutrients needed for proper growth and development during the first six months of a child's life. Similar studies were reported in Gojjam, Northwest Ethiopia,[32] Shire indeseallsaie, Northern Ethiopia,[19] Bule Hora district,

South Ethiopia,[4] Meskan district, South Ethiopia,[33] and Afar, Ethiopia.[20]

In the current study, previous exposure to diarrheal disease was significantly associated with increased risk of developing stunting and wasting. Children who had diarrheal disease in the past two weeks were 1.9 and 2 times more likely to be stunted and wasted respectively than those children without diarrheal disease. This could be due to the fact that diarrhea results in loss of appetite and malabsorption. Another possible explanation might be that a child with diarrhea loses weight and can easily become malnourished. Studies conducted in Pakistan,[28] Afar, Ethiopia,[20] Karat Town, Southern Ethiopia,[30] Machakel Woreda, Northwest Ethiopia,[31] Haramaya district, Eastern Ethiopia,[34] Bule Hora district, South Ethiopia,[4] revealed consistent findings with the current study.

This study indicated non-immunized children were 2 times more likely to be underweight than vaccinated children, this is reinforced by studies done in Afar, Ethiopia.[20] The possible explanation for this could be because vaccination is a cornerstone of child health interventions to reduce morbidity and mortality, thereby protecting children's nutritional status and leading to improved child growth and development.

Preterm birth was strongly associated with both wasting and being underweight. The possibility of being both wasted and underweight among preterm birth children was 3.7 and 1.8 times higher than term birth children, respectively. The reason for this could be explained due to the fact that prematurely born babies are at risk for poor growth, born with underdeveloped organs, brain damage, etc.

According to this study, child's age was a strong predictor for high prevalence of stunting. Children in the age range of 24–59 months old were 3.2 times more likely to be stunted than those children with age range from 0–6 months. This is supported by a study done in Ethiopia based on EDHS report.[35]

In the current study, maternal ANC follow up was also a factor related to child wasting and being underweight. Children born from mothers who had incomplete maternal ANC follow up were 3 and 2.5 times more likely to develop wasting and to be underweight, respectively than children born from mothers who had complete ANC follow-up. Also, children born from mothers who did not have ANC follow-up at all had 2.5 and 3 times higher risk of wasting and being underweight, respectively than children from mothers who had complete ANC follow-up. This is consistent with studies done in Kemissie special zone, Southwest Amhara,[23] and east Gojjam zone, Northwest Ethiopia.[32] This is because ANC can provide an opportunity to identify existing health risks in women and to prevent future health problems for their children.

The present study revealed that children born from mothers who did not wash their hands before feeding the child were 2 times more likely to be underweight than children from mothers who always washed their hands before feeding the child. This could be due to the fact that inadequate hygiene can place children at greater risk of water-borne diseases and several infections which worsen nutritional outcomes. This is in agreement with studies done in Machakel Woreda, Northwest Ethiopia,[31] and Tigray Region, Ethiopia.[26]

Conclusion and Recommendations

There was a higher prevalence of stunting (41%), wasting (33%), and underweight (26%) in Debre Berhan town compared to the national (Ethiopia) or regional (Amhara) malnutrition prevalence. Maternal illiteracy, the age of child, not breastfeeding exclusively, absence of ANC, exposure to diarrhea, preterm birth, not being vaccinated, and poor caretaker hand washing practice were identified risk factors of under-five malnutrition. Education and training for mothers on exclusive breastfeeding practice, child care, and infection prevention protocol should be given and further strengthened at community level. ANC program for all pregnant women should be initiated and established at all levels. Policymakers should pay special attention to policies targeted at reducing under-five malnutrition.

Limitations of the Study

Because the study had a cross-sectional design, causal inference might not be strong between the outcome and independent variables. There might also be recall and reporting bias in aspects of breastfeeding patterns, dietary diversity, and child's past illnesses.

Abbreviations

ANC, antenatal care; EBF, exclusive breastfeeding; EDHS, Ethiopian Demographic and Health Survey; EMDHS, Ethiopian Mini Demographic and Health Survey; HAZ, height-for-age Z score; IYCF, infant and young child feeding; MUAC, middle upper arm circumference; RERC, Research and Ethical Review Committee;

SD, standard deviation; WAZ, weight-for-age Z score; WHZ, weight-for-height Z score.

Data Sharing Statement

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

Ethical Approval and Consent to Participate

The ethical approval was obtained from Debre Berhan University, College of Health Science Research and Ethical Review Committee (RERC) protocol no; 017/19/CHS. Then, letters of cooperation were issued to Debre Berhan city municipality office ensuring the approval and necessary facilitation for smooth undertaking of the study. This study was conducted in accordance with the declaration of Helsinki. Verbal informed consent was approved by the RERC and then verbal informed consent was obtained from mothers or caretakers before being enrolled in the study. Anonymity and confidentiality of information were guaranteed.

Consent for Publication

Not applicable.

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Author Contributions

All authors made significant contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting, critically revising and agreed to submit to the current journal. All authors reviewed and agreed on all versions of the article before submission, during revision, gave final approval of the version to be published; agreed to take responsibility and be accountable for all aspects of the work.

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Disclosure

The authors reported no conflicts of interest for this work and declare that there is no conflict of interest regarding the publication of this paper.

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