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# Stunting, wasting and associated factors among children aged 6–24 months in Dabat health and demographic surveillance system site: A community based cross-sectional study in Ethiopia

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## Abstract

**Background:** Though there is a marked decline in burden of undernutrition, about 44 and 10% of children under five are stunted and wasted, respectively in Ethiopia. The highest prevalence of wasting occurs in young children (6–23 months), however literature are limited in these population groups. Therefore, this study aimed to assess stunting, wasting and associated factors among children aged 6–24 months in Dabat Health and Demographic Surveillance System (HDSS) site, northwest Ethiopia.

**Methods:** A community based cross-sectional study was conducted in Dabat HDSS site from May 01 to June 29, 2015. A total of 587 mother-child pairs were included in the study. A multivariate logistic regression analysis was carried out to identify factors associated with stunting and wasting, separately.

**Results:** The prevalence of stunting and wasting among children aged 6–24 months were 58.1 and 17.0%, respectively. Poor wealth status [Adjusted Odds Ratio (AOR) = 2.20; 95% Confidence Interval (CI): 1.42, 3.40], unavailability of latrine [AOR = 1.76; 95% CI: 1.17, 2.66], child age: 12–24 months [AOR = 3.24; 95% CI: 2.24, 4.69], not receiving maternal postnatal vitamin-A supplementation [AOR = 1.54; 95%: 1.02, 2.33] and source of family food: own food production [AOR = 1.71; 95% CI: 1.14, 2.57] were significantly associated with higher odds of stunting. However, only history of diarrheal morbidity was significantly associated with wasting [AOR = 2.06; 95% CI: 1.29, 3.30].

**Conclusions:** In this community, the magnitude of stunting and wasting exists as a severe public health concern. Therefore, improving socio-economic status, latrine and maternal postnatal vitamin-supplementation coverage are essential to mitigate the high burden of stunting. Besides, reducing the childhood diarrheal morbidity as well as strengthening early diagnosis and management of the problem are crucial to curve the high prevalence of wasting.

**Keywords:** Stunting, Wasting, Dabat health and demographic surveillance system, Ethiopia

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## Background

A marked decline has been made over the past few decades in the burden of child undernutrition in developing countries, including Ethiopia [1–3]. Regardless of this success, children aged under 5 years are still suffering from undernutrition in developing countries. Globally, 178 and 52 million children are stunted and wasted, respectively [4], 99 % of this burden is found in Sub-Saharan Africa and South Asian countries [5].

Annually, about 10.5 million child deaths are related to undernutrition, in which 98% of these mortalities are reported in developing countries [6]. Stunting is associated with poor physical and cognitive development as well as low school performance in children and adolescents [7, 8]. It is also found to hinder economic productivity of adults and Gross Domestic Product (GDP) of the nation at large [9]. The risk of mortality is higher among stunted children [10], even it is aggravated when stunting and wasting happened together [11]. Due to the intergenerational impact of chronic malnutrition, childhood stunting is correlated with the future maternal undernutrition and higher risk of death [8, 12]. Premature delivery and giving birth of underweight baby are commonly reported among undernourished mothers [13, 14].

Because of their rapid growth and increased vulnerability to infectious disease, children less than 2 years of age are considered as the most at risk groups for undernutrition. As a result, the World Health Organization (WHO) designed and supports the implementation of Infant and Young Child Feeding (IYCF) Strategies [15, 16], However poor feeding practice and health status continues as a strong determinants undernutrition [17, 18].

Accordingly, pre-lactate feeding [19], non-exclusive breastfeeding [20], low meal frequency and dietary diversity [21–23], and not taking prenatal iron supplementation [22] are correlated with stunting among children under-5 years. Furthermore, socio-demographic and environmental factors, such as maternal illiteracy [23], young age (0–23 months) [23], occupational status (being farmer and merchant) [20, 23], large families [20, 24], poor household wealth status [25] and sanitary practice [26], unavailability of latrine [27] and use of unprotected source of drinking water [28] are identified as the determinants of stunting.

Different studies also elicited the predictors of wasting, according to which sub-optimal duration of exclusive breastfeeding [29, 30], poor wealth status [31] and maternal education [32], large families [33], diarrheal and respiratory tract morbidities [34, 35], unavailability of latrine [36] and rural residence [37] are associated with increased odds of wasting among children under-5 years.

In Ethiopia, about 44 and 10% of children under-5 years are stunted and wasted, respectively [38] and the highest burden of wasting occurs in children aged 6–23 months. More than half (53%) of child mortality [39] and 16.5% loss of the Gross Domestic Product [40] are associated with undernutrition. It was proved that, one-third of stunting and one-fourth of child deaths could be prevented by implementing basic nutrition programs [41]. Cognizant of this fact, Ethiopia is found implementing different nutritional interventions to mitigate the high burden of undernutrition [42, 43], despite significant changes have not been attained [38].

Therefore, regular monitoring of the burden and determinants of undernutrition among young children (6–24 months) is important to show the severity (public health importance) of the problem and evaluate the in-place nutritional interventions. Despite their increased and unique vulnerability, little known about the magnitude of undernutrition in this population and majority of the former local studies focused on investigating the problem among under five children [3, 17, 24, 32, 34, 36, 38]. Therefore, this study aimed to assess stunting, wasting and associated factors among children aged 6–24 months in Dabat Health and Demographic Surveillance System (HDSS) site, northwest Ethiopia.

## Methods

### Study setting and design

A community-based cross-sectional study was conducted from May 01 to June 29, 2015 in Dabat HDSS site. The HDSS site is located in Dabat District, northwest Ethiopia. The district has an estimated population size of 145,458 living in 26 rural and 4 urban kebeles (smallest administration unit in Ethiopia). The livelihood of the residents by and large depends on subsistence farming. The HDSS site covers thirteen kebeles (four urban and nine rural kebeles) selected by considering different ecological zones (high land, middle land, and low land). A total of 67,385 people are living in these kebeles. The Dabat HDSS site has been running since November 1996, and collects information on vital events like birth, death, migration, and pregnancy registrations and its outcome on quarterly bases.

### Sample size and sampling procedure

Initially, the study was aimed to assess the nutritional status and feeding practice of children aged 6–59 months in Dabat HDSS site. Of the total kebeles (thirteen) under surveillance, eight kebeles were selected using lottery method. Accordingly, all mothers with children aged 6–59 months who lived in the selected kebeles for at least 6 months were included in the original survey. For

households with multiple children fulfilling the inclusion criteria, a child was selected using lottery method.

As part of the original survey, this particular study utilized the data extracted from the original survey database. Accordingly, only mothers with children aged 6–24 months were considered to investigate the magnitude of stunting and wasting in these young children. To this effect, sample size was calculated using Epi-info version 3.7 by considering the following assumptions: 47% as the prevalence of stunting among children aged 6–24 months [3], 95% level of confidence and 5% margin of error. A design effect of 1.5 and 2.5% non-response rate were also anticipated which gives a final sample size of 588.

#### Data collection tools and procedure

Data from the mothers or caregivers of the children were collected through home to home visits using structured, pretested and interviewer-administered questionnaire. The questionnaire was designed to capture socio-demographic and economic characteristics, feeding pattern, health and environmental related information. To maintain consistency, the questionnaire was first translated from English to Amharic (the native language of the study area) and was retranslated back to English. The questionnaire was pre-tested on 5% of the total sample out of the study area; accordingly the acceptability and applicability of the procedures and tools were evaluated. Fourteen data collectors and three field supervisors working in the HDSS site were recruited for the study. Training regarding anthropometric measurements and techniques of interview was given to data collectors and supervisors.

Child weight was measured to the nearest 0.1 kg by the seca beam balance (German, Serial No. 5755086138219) with graduation of 0.1 kg and a measuring range of up to 25 kg. Weight was taken with light clothing and no shoes. Instrument calibration was done before weighing each child. Furthermore, the weighing scale was checked daily against the standard weight for accuracy. The length of a child (aged 6–23 months) was measured using a horizontal wooden length board in recumbent position, and read to the nearest 0.1 cm. To check edema, normal thumb pressure was applied on both feet for 3 s. The data collectors checked whether a shallow print remained on both feet or not when the thumb was lifted.

Early initiation of breastfeeding was defined as putting the newborn to the breast within 1 h of birth. Therefore, the study participants were asked as “how long after birth did you first put [name] to the breast even if your breast milk did not arrive yet?”. If the mother responded as within 1 h of delivery, it was considered as early initiation of breastfeeding, otherwise it was defined as late

initiation of breastfeeding. Similarly, initiation of complementary feeding was defined as early initiation, timely initiation and lately initiation if the mother initiated complementary feeding to the index child before sixth month, at sixth month and after sixth months of the child's age, respectively.

A standardized seven food group containing Dietary Diversity Score (DDS) was used to qualitatively assess the dietary intake of children [44]. A 24 h dietary recall method was used, accordingly the mothers were asked to report the food items consumed by the child in the previous 24-h preceding the data of survey. By considering four food groups as the minimum acceptable dietary diversity, a child with a DDS of less than four was classified as poor dietary diversity; otherwise it was deemed to have good dietary diversity.

The household wealth index was computed using a composite indicator for urban and rural residents by considering properties such as, selected household assets and size of agricultural land. Using Principal Component Analysis (PCA), the factor scores were summed and ranked into poor, medium and rich. Data were checked for completeness and its quality, on daily basis, by the field supervisors.

#### Data analysis

Data were edited, coded and entered into the EPI-info version 3.5.3 statistical software, and exported to SPSS version 20 for analysis. Nutrition related data (sex, age, height, weight and edema status) were analyzed using the WHO Anthro plus software. The Z-scores of indices, Weight-for-Height Z-score (WHZ) and Height-for-Age Z-score (HAZ) were calculated and compared using the WHO Multicenter Growth Reference Standard. A child whose HAZ less than  $-2$  Standard Deviation (SD) from the reference population was defined as stunted, while a child with WHZ less than  $-2$  SD from the reference population was classified as wasted [45].

Descriptive statistics, including frequencies and proportions were used to summarize the variables. Bivariate analysis was done individually for all independent variables with stunting and wasting. Variables with a *p*-values of  $<0.2$  (child age and dietary diversity score, maternal education, occupation and postnatal vitamin-A supplementation, fathers education, household wealth status, availability of latrine, source of drinking water and main source of family food) in the bivariate analysis were entered to a multivariate logistic regression analysis to identify the independent determinants of stunting. Regarding the determinants of wasting, variables with a *P*-value of  $<0.2$  (history of diarrheal morbidity and fever, maternal education and employment status) in the bivariate analysis were fitted to multivariate analysis. Both Crude Odds Ratio (COR) and the Adjusted Odds

Ratio (AOR) with a corresponding 95% Confidence Interval (CI) were computed to show the strength of the association. In the multivariate logistic regression analysis, variables with a  $p$ -value of  $<0.05$  were considered as statistically significant. Hosmer and Lemeshow goodness of fit test was checked and it was 0.77 indicating the model well fits the data.

## Results

A total of 587 mother-child pairs were included for analysis, and the mean age ( $\pm$ Standard Deviation, SD) of children was 15.0 ( $\pm 5.7$ ) months. Most of the mothers had no formal education (71%), were housewives (60.6%) and currently married (90.1%). Nearly three-fourth (70.4) of the households accessed food for consumption mainly from their farm while one-quarter (26.2%) through purchasing from market (Table 1).

About half of the mothers (52.5%) took iron-folate supplements during pregnancy, but only few (1.7%) of them ate extra meal compared to their pre-pregnancy dietary habit. Though almost all of children (99.5%) were breastfed at one time in their life, only 61.5% continued to exclusively breastfed for 6 months. Only 4.3% of children consumed complementary food composed of a minimum dietary diversity. However, above three-fourth (78.9%) of children took vitamin-A supplementation in the previous 12 months prior to the data of survey while only 24.7% mothers were given the postnatal vitamin-A supplementation. One-fourth (24.4%) of the children had diarrheal morbidity in the past 2 weeks prior to the date of survey (Table 2). Despite two-third of households used unsafe source of water for consumption, only 2.4% mothers were found to treat water on regular basis (always) before consumption. Latrine was also available in 28.1% of the households (Table 3).

The prevalence of stunting and wasting among children aged 6–24 months were 58.1% [95% CI; 50.3, 65.9%] and 17.0% [95% CI; 11.1, 22.9%], respectively. Besides, the burden of stunting and wasting among children aged 12–24 months was 44.6 and 11.6%, respectively, while it was 13.5 and 5.4% in infants aged 6–11 months.

In the bivariate analysis, child age, maternal education, occupation and postnatal vitamin-A supplementation, fathers' education, household wealth status, availability of latrine and main source of family food were significantly associated with stunting. However, the multivariate logistic regression analysis detected that child age, maternal postnatal vitamin-A supplementation, latrine availability, main source of family food and household wealth status were remained significantly and independently associate with stunting.

Thus, the odds of stunting were 54% [AOR = 1.54; 95%: 1.02, 2.33] higher among children whose

**Table 1** Socio-demographic and economic characteristics of children (6–24 months) and their parents, Dabat District, Northwest Ethiopia, 2015

Characteristics	Frequency	Percent
Child age in months		
6–11	196	33.4
12–24	391	66.6
Mean ( $\pm$ SD) age of children	(15.0 $\pm$ 5.7)	
Head of the household		
Female	18	3.1
Male	569	96.9
Mothers age		
15–34 years	371	63.2
35–50 years	216	36.8
Marital status		
Currently unmarried	58	9.9
Currently married	529	90.1
Household size		
$\leq 4$	224	38.2
5–7	280	47.7
8–10	83	14.1
Maternal education		
No formal education	417	71.0
Primary education	76	12.9
Secondary education	94	16.0
Maternal employment status		
Housewife	356	60.6
Farmer	143	24.4
Others <sup>a</sup>	88	15.0
Father education		
No formal education	389	66.3
Formal education	198	33.7
Main source of family food		
Own production	413	70.4
Purchasing	154	26.2
Others <sup>b</sup>	20	3.4
Wealth status		
Poor	210	35.8
Medium	198	33.7
Rich	179	30.5

<sup>a</sup> Students, unemployed, servant, own business

<sup>b</sup> Food donation from government and families

mothers did not receive postnatal vitamin-A supplementation compared to their counterparts. The odds of stunting among children aged 12–24 months were 3.24 [AOR = 3.24; 2.24, 4.69] times higher compared to infants aged 6–11 months. The higher likelihood

**Table 2** Feeding practice, micronutrient supplementation and morbidity related characteristics of study participants, Dabat District, Northwest Ethiopia, 2015

Characteristics	Frequency	Percent
Feeding during pregnancy		
Less than before/usual	356	60.6
As usual	221	37.6
Greater than usual/extra foods	10	1.7
Prenatal iron-folate supplementation		
Yes	308	52.5
No	279	47.5
Colostrum		
Given to the child	324	55.2
Discarded	263	44.8
Ever breastfeeding		
Yes	584	99.5
No	3	0.5
Initiation of breastfeeding		
Early initiation	333	57.0
Late initiation	251	43.0
Exclusive breastfeeding		
Yes	361	61.5
No	226	38.5
Pre-lacteal feeding		
Yes	137	23.3
No	450	76.7
Complementary feeding initiation		
Early initiation	109	18.6
Timely initiation	314	53.5
Lately initiation	164	27.9
Bottle feeding in the previous 24 h		
Yes	40	6.8
No	547	93.2
Dietary diversity score		
< 4 food groups	562	95.7
≥ 4 food groups	25	4.3
Maternal Vitamin A supplementation		
Yes	145	24.7
No	442	75.3
History of fever in the previous 2 weeks		
Yes	237	40.4
No	350	59.6
History of diarrheal disease in the previous 2 weeks		
Yes	143	24.4
No	444	75.6

**Table 2** Feeding practice, micronutrient supplementation and morbidity related characteristics of study participants, Dabat District, Northwest Ethiopia, 2015 (Continued)

Child vitamin A supplementation in the previous 12 months		
Yes	463	78.9
No	124	21.1

of stunting was found among children from households without latrine [AOR = 1.76; 95% CI: 1.17, 2.66] and with poor wealth status [AOR = 2.20; CI: 1.42, 3.40]. Finally, the odds of stunting were 71% higher among children whose families accessed food for household consumption from their own farm [AOR = 1.71; 95% CI: 1.14, 2.57] compared to those children whose families accessed food from other sources (Table 4).

Regarding the determinants of wasting, both bivariate and multivariate analyses indicated that only diarrheal morbidity remained significantly and independently associated with wasting. Accordingly, the odds of wasting were 2.06 times [AOR = 2.06; CI: 1.29, 3.30] higher among children with history of diarrheal disease compared to those who had no history of diarrheal morbidity in the past 2 weeks prior to the date survey (Table 5).

**Table 3** Environmental health related characteristics of the households, Dabat District, northwest Ethiopia, 2015

Characteristics	Frequency	Percent (%)
Source of drinking water		
Safe source <sup>a</sup>	212	36.1
Unsafe source <sup>b</sup>	375	63.9
Water treatment habit		
Not at all	550	93.7
Sometimes	23	3.9
Always	14	2.4
Availability of latrine		
Yes	165	28.1
No	422	71.9
Waste disposal		
Appropriate <sup>c</sup>	74	12.6
Inappropriate <sup>d</sup>	513	87.4
Hand washing habit after toilet		
Not at all	71	12.1
Sometimes	111	18.9
Always	405	69

<sup>a</sup> Piped, protected well and spring water

<sup>b</sup> Unprotected well, spring and surface water

<sup>c</sup> Collected by municipality, buried and burned

<sup>d</sup> Dumped in street/open space, compound and river

**Table 4** Factors associated with stunting among children aged 6–24 months, Dabat District, Northwest Ethiopia, 2015

Variables	Stunting		COR [95% CI]	AOR [95% CI]
	Yes (#)	No (#)		
Maternal education				
No formal education	254	163	2.20 (1.39,3.46)	1.56 (0.91,2.69)
Primary education	48	28	2.42 (1.30,4.50)	1.84 (0.92,3.63)
Secondary and above education	39	55	1.00	1.00
Maternal occupation				
Housewife	201	155	1.49 (0.93,2.37)	0.96 (0.52,1.78)
Farmer	99	44	2.58 (1.49,4.47)	1.41 (0.69,2.89)
Others <sup>a</sup>	41	47	1.00	1.00
Father education				
No formal education	238	151	1.45 (1.03,2.05)	1.09 (0.72,1.66)
Formal education	103	95	1.00	1.00
Wealth status				
Poor	143	67	2.36 (1.56,3.57)	2.20 (1.42,3.40)*
Medium	113	85	1.43 (0.98,2.21)	1.30 (0.83,2.02)
Rich	85	94	1.00	1.00
Main source of family food				
Own production	256	157	1.71 (1.91,2.44)	1.71 (1.14,2.57)*
Others <sup>b</sup>	85	89	1.00	1.00
Source of drinking water				
safe source	111	101	1.00	1.00
unsafe source	230	145	1.44 (1.03,2.03)	1.21 (0.79,1.84)
Availability of latrine				
Yes	77	88	1.00	1.00
No	264	158	1.19 (1.33,2.75)	1.76 (1.17,2.66)*
Maternal Vitamin A supplementation				
Yes	73	72	1.00	1.00
No	268	174	1.52 (1.04,2.22)	1.54 (1.02,2.33)*
Dietary diversity score				
< 4 food groups	330	232	1.81 (0.81,4.06)	1.17 (0.69,4.04)
≥ 4 food groups	11	14	1.00	1.00
Child age				
6–11 months	79	117	1.00	1
12–24 months	262	129	3.01 (2.12,4.29)	3.24 (2.24,4.69)*

\* Significant at  $p$ -value < 0.05<sup>a</sup> Students, unemployed, servant, own business<sup>b</sup> Purchasing, and donation from government or families

## Discussion

This study revealed that, the prevalence of stunting was 58.1% among children aged 6–24 months. The current burden of stunting suggests the severe public health significance of the problem [46]. Similar magnitude of stunting was also reported in Central Africa Republic (61.5%) [47] and Kenya (51%) [48]. However, the finding was higher than what was reported in Egypt (20.3%) [49]. The discrepancy might be related to variations in

**Table 5** Factors associated with wasting among children aged 6–24 months in Dabat District, Northwest, Ethiopia, 2015

Variables	Wasting		COR (95%CI)	AOR (95%CI)
	Yes (#)	No (#)		
Maternal education				
No formal education	64	353	0.80 (0.34,1.03)	0.67 (0.35,1.25)
Primary education	14	62	0.74 (0.35,1.57)	0.73 (0.33,1.60)
Secondary education and above	22	72	1.00	1.00
Maternal occupation				
Housewife	49	307	0.55 (0.32,1.05)	0.63 (0.34,1.14)
Farmer	32	111	1.05 (0.55,1.99)	1.21 (0.63,2.33)
Others	19	69	1.00	1.00
History of fever in the past 2 weeks				
Yes	49	188	1.53 (0.99,2.34)	1.07 (0.61,1.86)
No	51	299	1.00	1.00
Diarrheal morbidity in the past 2 weeks				
No	64	380	1.00	1.00
Yes	36	107	2.00 (1.26,3.16)	2.06 (1.29,3.30)*

\* Significant at a  $P$ -value of <0.05

residence and level of income between the study participants. In contrast to the latter study, the participants of the current study were majorly rural inhabitants. Poor child feeding and caring practice and health care access is documented in the rural Ethiopia [38]. This suggests that unequal allocation of resources cause to inequalities in child health outcomes between rural and urban settlements [50]. In addition, stunting is more common in the rural areas [51]. On the other hand, the livelihood of the study participants is mainly depend on subsistence, low-yield and rain-fed farming. The output of subsistence farming is mostly for local requirement with little or no surplus for trade [52], which ultimately impairs the household food security status. Household food insecurity is associated with poor linear growth, stunting [53].

Compared to the WHO cut-off point to declare the public health importance of undernutrition, the prevalence of wasting (17.0%) existed as a critical public health problem [46]. The finding was in line with reports of other developing countries, such as Central Africa Republic (20.2%) [47] and Sri Lanka (17.1%) [54]. However, compared to this study, the lower prevalence of wasting is reported in the rural Cambodia (10%) [55]. The study in Cambodia was conducted among Food and Agriculture Organization (FAO) project beneficiaries which aimed to promote optimal IYCF practice and improve the household food security status through increasing market availability, production and diversification of food. Research findings from different low and middle income countries showed that improved agriculture is one of the key nutrition sensitive interventions to rectify maternal and child undernutrition [56–58]. However, the agricultural practice

in Ethiopia, including the study area, is rain feed, based on poor technologies, and there is also poor market regulation system for food products [59, 60].

The result of multivariable analysis showed that, the likelihood of being stunted was 2.20 times higher among children from the poor families compared to those from the rich families. The finding was supported by the reports elsewhere [61, 62]. The plausible explanation might be related to the negative effect of poor wealth status on the household food access, utilization of health services, availability of improved water sources, and sanitation facilities [63].

The results of the present study also detected that, the odds of stunting were increased among children from a household without latrine. Similarly, the previous reports in Africa indicated the decreased odds of childhood stunting in households with latrine [62, 64]. In fact, unfavorable health environment caused by inadequate sanitation increases vulnerability to communicable diseases which is considered as immediate causes of undernutrition, including stunting [63].

The uncommon finding of this study was increased odds of stunting among children whose families accessed food mainly from farm (own production). This might be due to low agricultural productivity and poor complementary feeding practice in the study area. In fact, own production of food does not necessarily mean ensuring per-capita food availability and nutritional security. In Ethiopia, including the study area, complementary food is mainly prepared from cereal (Teff, barely and sorghum) based food products where the traditional staple food called 'Injera' (a yeast-risen flatbread made of a blend of cereals) is usually served with legumes or pulses. Such feeding practices increase the vulnerability of infants and children to poor energy and micronutrient intake [65].

Children whose mothers did not receive the postnatal vitamin-A supplementation were found with increased odds of stunting compared to their counterparts. Improving vitamin-A status of children is one of the proven child survival strategies, specially it is found to significantly reduce risk of morbidity and mortality from infectious diseases [66, 67]. Frequent episodes of infectious disease, such as diarrhea and respiratory tract infections are strongly associated with higher risk of stunting [68]. In Ethiopia, most of the pregnant mothers are suffering from vitamin-A deficiency [69]. As a result, postnatal period is a window of opportunity to improve mothers vitamin-A status thereby increasing the retinol level of breast milk. By doing so, the breastfed infants will get adequate amount of vitamin-A which further helps to reduce the risk of infectious disease episodes through boosting their immunity.

Likewise, the odds of stunting were higher among children aged 12–24 months compared to those aged

6–11 months. This finding was in agreement with the report from Central Africa Republic, in which poor growth of children is correlated with old age of children [47]. Studies of other developing countries also claimed that stunting is less common in early infancy as they are on breastfeeding [70], however, because of inappropriate complementary feeding practice and higher nutritional demand, the risk of impaired linear growth increases as the child's age advances [71].

Finally, this study reported that, children with history of diarrheal morbidity in the previous 2 weeks preceding the date survey were found with higher odds of developing wasting. Similar findings were also reported by the previous local studies [24, 34]. Obviously, diarrhea is associated with malabsorption of nutrients, significant nutrient and fluids loss and reduced appetite [72]. Delayed treatment due to mothers poor health seeking behavior and inappropriate home based management of diarrhea, such as fluid restriction and decreasing or stopping food intake are the commonly practiced in most of the mothers in Ethiopia, which in turn increases the vulnerability the child to develop wasting [73, 74].

This is one of the few studies revealing the magnitude of stunting and wasting in the most vulnerable population groups, children aged 6–24 months. Nevertheless, it is not free from some of limitations. Firstly, though intensive training, regular field supervision and pre-test were done, the study was not free from measurement and recall bias while conducting anthropometric and child feeding practice assessments, respectively.

## Conclusions

The prevalence of stunting and wasting are high in Dabat HDSS site which indicates that undernutrition is the severe public health concern among children. In addition, household wealth status, latrine availability, maternal postnatal vitamin-A supplementation, child age and main source of family food were significantly associated with stunting. But, only diarrheal morbidity was identified as the key determinant of wasting. Therefore, improving socio-economic status, latrine and maternal postnatal vitamin-supplementation coverage are essential to mitigate the high burden of stunting. It is also crucial to strengthen the implementation of the current measures focusing on reducing the occurrence of childhood diarrheal morbidity as well as early diagnosis and management of the problem.

## Abbreviations

PCA: Principal Component Analysis; GDP: Gross domestic production; WHO: World Health Organization; AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence Interval; IYCF: Infant and young child feeding; DDS: Dietary Diversity Score; SD: Standard Deviation; HDSS: Health and Demographic Surveillance System

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### Availability of data and materials

Data will be available upon request from the corresponding author.

### Authors' contribution

AT conceived the study, developed the tool, coordinated data collection, and carried out the statistical analysis and drafted the manuscript. GAB participated in the design of the study, developed the tool, and coordinated data collection. TD conceived the study, participated in the statistical analysis, and drafted the manuscript. MMW conceived the study and review the drafted manuscript. All authors read and approved the final manuscript.

### Competing interests

The authors declare that they have no competing interests.

### Consent for publication

Not applicable.

### Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of the University of Gondar (Ref No. 550/09/07). An official permission letter was secured from the Dabat HDSS site. The study did not involve any invasive procedures and reporting of any response for intervention. So, the study posed a low or not more than a minimal risk to the study participants. Accordingly, all eligible mothers were informed about the purpose of the study, and interview was held only with those who agreed to give verbal consent to participate. The right of a participant to withdraw from the study at any time, without any precondition was disclosed unequivocally. Moreover, the confidentiality of information was guaranteed by using code numbers rather than personal identifiers and by keeping the questionnaire locked.

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