Determinants of Stunting among Children Aged 6-23 Months of Age in Pastoral Community, Afar Region, Ethiopia: Unmatched Case-Control Study

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Abstract: *Background*: Globally, stunting is a public health concern, more of in developing counties, including Ethiopia. Once occurred, in the first two years of life, it is irreversible and has long-lasting harmful consequences. Exploring the determinants has pivotal importance for evidence-based interventions. Therefore, the rationale of this study was to identify determinants of stunting among children aged 6-23 months in the pastoralist community, Afar region, Ethiopia.

Method: A community-based unmatched case-control study was conducted among 381 (cases=126, controls 255) study participants from February 15/2017 to March 30/2017. Cases and controls were identified consecutively using the world health organization growth monitoring chart.

Data was collected by interviewer-administered questionnaires and anthropometric measurements. Statistical significance was declared at p-value < 0.05 in the final multivariable logistic regression model.

Result: Maternal education (AOR:0.34, 95% CI: 0.16, 0.77), maternal under-nutrition (AOR:2.91, 95% CI:1.51, 5.60), number of under-five children within the household (AOR:2.66, 95% CI: 1.38, 5.10), latrine ownership (AOR:0.28, 95% CI:0.15, 0.55), minimum Dietary Diversity score of children (AOR:0.41, 95% CI:0.22, 0.75), child age (AOR:1.76, 95% CI:1.01, 3.09), colostrum intake (AOR:3.03, 95%CI:1.62, 5.66), and exclusively breastfeed for the first six months (AOR:3.20, 95% CI:1.72,5.95) were found to be determinants of stunting.

Conclusion: This study found that determinants of childhood stunting are multifactorial. Maternal, household and child-related characteristics are associated with childhood stunting. Therefore, to improve childhood nutritional status, inter-sectoral collaboration and commitment are vital.

Keywords: Afar, Case-control, Children aged 6-23 months, Ethiopia, Golina district, Pastoralist, Stunting.

INTRODUCTION

Stunting is one form of under-nutrition, which is defined as height or length for age below minus two standard deviations from the median of the world health organization (WHO) child growth standards [1]. Globally, in 2020, an estimated 149 million under-five children were stunted in which the lion share comes from Asia and Africa [2]. Stunting remains one of the public health concerns in Ethiopia, in which 37% of under-five children were stunted. In the Afar region, this figure is high, 43% [3].

Childhood stunting in the critical window, from conception to the first two years of life, is a result of modifiable factors such as cumulative long-term insufficient nutrient intake and inadequate feeding practices, improper child and maternal care, repeated bouts of infection, unhealthy environmental and socio-cultural conditions [4, 5]. The risk of stunting is highest in the first 1000 days window of opportunity [4, 6]. Once stunting occurred before the age of two years, its effects are critical and not limited to the boundary of childhood but rather persist to adulthood and become intergenerational [7]. Interventions beyond this period have little impact in reversing stunting, instead prone the child to double burden of malnutrition [8, 9].

Stunting before the age of two years has a significant consequence at the individual, household, community, and even national level. It is associated with higher morbidity and mortality [10], reduced intellectual capacity, increased risk of adulthood obesity, and metabolic disorders [11, 12]. A one per cent loss in adult height because of childhood stunting leads to a 1.4% loss in economic productivity. Economists estimate that stunting can reduce a country's gross domestic product by up to 3 % [13].

In Ethiopia, irrespective of good progress in the reduction of stunting in the last few decades, the figure

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still implies it is a significant public health problem. The country continued its efforts by launching the Seqota declaration to end childhood stunting by 2030, but if the current trend continues the target couldn't be achieved [14].

To accelerating its reduction and for achieving the set targets, Ethiopia should do context-specified evidence-based interventions. Thus, the rationale of this study was to identify determinants of stunting among children aged 6-23 months in the pastoralist community, Afar, Ethiopia.

METHODS AND MATERIALS

Study Setting and Design

A community-based unmatched case-control study was conducted in Golina district from February 15 to March 30/2017. The district resides in the Afar regional state located around 691 km Northeast of Addis Ababa, the capital city of Ethiopia, and 220 km Northwest of Samara, the capital city of the Afar region. According to Ethiopian 2007 census the total population of the district was estimated to be 56,929, of which 5,727 were under-five children. In the district, there was one general hospital, two health centres, and ten functional health posts. The populations are mainly pastoralist communities.

Sample Size Determination

The sample size was determined using Epi info 7, considering the assumptions of 95% confidence interval, 80% power, and the ratio of cases to control 1:2, and using different predictors from previous studies [15-17]. The final calculated sample size was 389 (129 cases and 258 controls), including the 10% non-response rate allowance (Table **1**).

Sampling Technique and Procedure

Golina district had a total of eight kebeles. Four kebeles were selected randomly, and the sample size was allocated proportionally; based on the number of children less than two years of age found from the health extension workers' family folder. In each selected kebele identification of cases and controls was performed using the WHO child growth monitoring chart (Supplementary Figure **1**).

Cases and controls were selected consecutively in each selected kebeles. Once the child height and weight are measured, their status (either case or control) was determined using the growth monitoring chart considering their age and sex. Cases were children aged 6-23 months who measured below -2 standard deviation (SD), and controls were children with the same age range but measuring -2 and above SD from the median length-for-age of the WHO reference standard [1]. For each identified case within one household, two consecutive controls within the near-by households were considered. In households having two or more eligible cases or controls, one was selected randomly.

Data Collection Procedure and Quality Assurance

A semi-structured questionnaire was developed through a critical review of the literature. The questionnaire was prepared in English and translated into the local language (Afar), and pre-testing was done in 10% of the sample size in none selected kebeles of the district. Data were collected via a face-to-face interview with mothers of children aged 6-23 months and measuring anthropometry of children.

For data collection, and supervision, four female diploma-holder health professionals and two degree-holder male public health professionals were recruited, respectively. They were selected based on their fluency in the local language, and training had given on the data collection procedures.

Anthropometric measurements' were performed according to WHO standardized procedures [1].

Table 1: Predictor Variables Selected for Determining Sample Size for Determinants of Stunting among Children Aged 6-23 Months in Golina District, Afar, Ethiopia

No	Significant predictors	Citation	CI	Power	Cases: control	Per cent of exposure (%)		Samples size including a 10% non-response rate		
						Cases	Controls	Cases	Controls	Total
1	Place of residence	[15]	95	80	1:2	52.2	30.8	68	136	204
2	Feed colostrum	[16]	95	80	1:2	52.0	32.2	79	158	237
3	Family size	[17]	95	80	1:2	66.0	50.6	129	258	387
4	Prelacteal feed	[18]	95	80	1:2	48.3	32.1	115	229	344

Maternal weight was measured using United Nations International Child Emergency Fund (UNICEF) electronic weighing scales with a maximum of 150kg capacity and 0.1kg accuracy. The weighing scales were calibrated and standardized every morning, using a 5 kg standard weight. The height of the mother was measured using a portable stadiometer to the nearest 1 centimetre (cm). Maternal mid-upper arm circumference (MUAC) was measured using WHO MUAC measuring tape with 0.1 cm accuracy. The child length measurement was done in a recumbent position using horizontal boards to the nearest 0.1 cm. To minimize measurement error, double measurements were done for each anthropometry, and the average was recorded.

The child dietary diversity score (CDDS) was determined using a 24-hours dietary recall method, classified as low (<3 food groups), medium (4 to 5 food groups), and high (> 6 food groups). The minimum dietary diversity score (MDDS) was determined, by calculating the number of food groups the children consume regardless of the portion size, 24-hours preceding the data collection day. It is considered acceptable if the child consumes four or more food groups from the seven food groups. The minimum meal frequency (MMF) of the child was calculated by grouping child age into two (6-8 months and 9-23 months). The acceptable MMF for children aged 6-8 months is two or more times per 24-hours, and for children aged 9-23 months, it is three or more times. The food and agricultural organization (FAO) meal frequency questionnaire was also used to determine the weekly food group consumption of the children [18, 19].

The age of children and birth weight was determined using written official documents like vaccination cards. For those who had no written evidence of birth date, a pre-prepared local calendar, and cross-checking with the other family member were done. The vaccination status of the child was assessed by card, Bacille Calmette-Guérin (BCG) scar, and mother recalled.

Data Processing and Analysis

Data were edited, coded, and entered into Epi data version 4.2 and exported to SPSS version 22 for analysis. Characteristics of study participants were summarized using descriptive statistics. Bivariable and multivariable logistic regression was used to identify independent predictors of childhood stunting. Predictor variables with the P-value of < 0.25 at bivariable analysis were transferred to the multivariable model and analyzed using the backward stepwise elimination. The strength of association was measured through adjusted odds ratios at a 95% confidence interval. Predictor variables with P-value <0.05 at the multivariable logistic regression model were declared statistically significant.

Multicollinearity was examined using Standard error cut-off 2, but no variable was found. The percentage of the model that was accurately classified was 76%, and Hosmer and Lemeshow chi-square goodness of fit test P-value was 0.605, indicating the model fits best.

RESULT

Socio-Demographic Characteristics of Study Participants

A total of 381 (126 cases and 255 controls) study participants were included in this study. Regarding residence, 96(76.2%) of cases, and 199(78%) of controls were lived in rural areas. One hundred thirteen (89.7%) of mothers of cases and 169(66.3%) of controls have not attended formal education (Table **2**).

Maternal and Child Healthcare-Related Characteristics

Regarding antenatal care (ANC) follow-up, 44(34.9%) of mothers of cases, and 106(41.6%) of controls had undergone at least one antenatal care visit. Institutional delivery among cases and controls was 21(16.7%) and 62(24.3%), respectively (Table **3**).

Maternal Nutritional Status and Feeding Practice

Only 27(21.4%) of mothers from cases and 63(24.7%) of mothers from controls got nutritional counselling services. The mean (±SD) MUAC, height, and BMI of mothers were 25.2(±2.7) cm, 1.6(±0.1) m, 20.5(±2.7) kg/m^2 among cases, and 26.6(±2.8) cm, 1.6(±0.1) m, 21.7(±2.6) kg/m^2 among controls, respectively (Table **4**).

Child Feeding Characteristics

Colostrum feeding among cases was 87(69%), while among controls 217(85.1%). Prelacteal feeding among cases and controls was 27(21.4%) and 34(13.3%), respectively. Around one-fifth, 26 (20.6 %) of cases and 107(42%) of controls were exclusively breastfed for the first six months. Only 23(18.4%) of

Table 2: Socio-Demographic Characteristics of Study Participants in Golina District, Afar Region, Ethiopia, 2017

Variable	Category	Cases (n=126) n (%)	Controls(n=255) n (%)
Residence	Rural	96(76.2)	199(78)
	Urban	30(23.8)	56(22)
Ethnicity	Afar	106(84.1)	212(83.1)
	Amhara	14(11.1)	30(11.8)
	Others*	6(4.8)	13(5.1)
Religion	Muslim	116(92.1)	233(91.4)
	Orthodox	7(5.6)	21(8.2)
	Others**	3(2.3)	1(0.4)
Maternal age (in a year)	15-24	27(21.4)	74(29)
	25-34	77(61.1)	140(54.9)
	≥35	22(17.5)	41(16.1)
	Mean (±SD)	29(±5)	27(±6)
Maternal marital status	Married	119(94.4)	243(95.3)
	Others***	7(5.6)	12(4.7)
Maternal educational status	Not attend formal education	113(89.7)	169(66.3)
	Attend formal education	13(10.3)	86(33.7)
Maternal occupation	Pastoralist	79(62.7)	162(63.5)
	Housewife	25(19.8)	43(16.9)
	Gov't employee	12(9.5)	33(12.9)
	Others****	10(8.0)	17(6.7)
Fathers educational status (n=362)	Not attend formal education	78(65.5)	151(62.1)
	Attend formal education	41(34.5)	92(37.9)
Fathers occupation (n=362)	Government employee	21(17.6)	46(18.9)
	Pastoralist	88(73.9)	168(69.1)
	Others*	10(8.4)	29(11.9)
Family size	≤4	36(28.6)	76(29.8)
	>4	90(71.4)	179(70.2)
	Mean (+SD)	6(±2)	5(±2)
Number of U-5 children within the household	One child	20(15.9)	96(37.6)
	Two or more children	106(84.1)	159(62.4)
Decision maker of the household	Mostly father	52(41.3)	92(36.1)
	Mostly mother	12(9.5)	24(9.4)
	Jointly	62(49.2)	139(54.5)
Sex of the child	Male	65(51.6)	117(45.9)
	Female	61(48.4)	138(54.1)
Child age	6-11 months	34(27)	107(42)
	12-23 months	92(73)	148(58)
	Mean (±SD)	15(±5)	13(±5)

*Protestant, catholic, ** Tigre, SNNP, Oromo, ***Single, divorced, widowed, ****Merchant, Student, non-government employee, daily labourer.

Table 3: Maternal and Child Healthcare-Related Characteristics of Study Participants in Golina District, Afar, Ethiopia, 2017

Variable	Category	Cases (n=126) n (%)	Controls (n=255) n (%)
ANC follow-up	Yes	44(34.9)	106(41.6)
Place of delivery	Home	105(83.3)	193(75.7)
Vaccination status of the child	Yes	56(44.4)	130(51)
Gestational age of the child	Preterm	14(11.1)	9(3.5)
	Term	108(85.7)	234(91.8)
	Post-term	4(3.2)	12(4.7)
Birth weight of the child*	Small	16(12.7)	23(9)
	Medium	104(82.5)	221(86.7)
	Large	6(4.8)	11(4.3)
Previous birth interval**	First child	13(10.4)	40(15.7)
	< 24months	89(70.6)	157(61.6)
	≥ 24 months	24(19)	58(22.7)
Birth order of the child***	≤ 3	57(45.2)	130(51)
	4-5	38(30.2)	70(27.5)
	≥ 6	31(24.6)	55(21.5)

*Recorded weight and/or maternal judgment of the birth size, **The period between the conception of the index child and the birth date of the previous child, ***The order of childbirth from all successive births.

Table 4: Maternal Nutritional Status and Feeding Practice of Study Participants in Golina District, Afar Region, Ethiopia, 2017

Variables	Category	Cases (n=126) n (%)	Controls(n=255) n (%)
Nutritional counselling*	Yes	27(21.4)	63(24.7)
Extra meal intake during pregnancy**	Yes	18(14.3)	47(18.4)
Extra meal intake during lactation**	Yes	27(21.4)	80(31.4)
Maternal MUAC (cm) (n=368)	< 23	25(20.5)	39(15.9)
	≥23	97(79.5)	207(88.1)
	Mean (±SD)	25.2(2.7)	26.6(2.8)
Maternal height (meter) (n=368)	≤1.45	3(2.4)	7(2.8)
	>1.45	120(97.6)	239(97.2)
	Mean (±SD)	1.6(±0.1)	1.6(±0.1)
Maternal body mass index (BMI) in kg/m^2 (n=353)	<18.5	33(28.5)	40(16.9)
	18.5-24.9	73(62.9)	173(73)
	25-29.9	10(8.6)	23(9.7)
	≥30	-	1(0.4)
	Mean(±SD)	20.5(±2.7)	21.7(±2.6)

*Counseling on maternal and child feeding practice, **One more meal (dish) from the usual.

Table 5: Feeding Practices of Children in Golina District, Afar Region, Ethiopia, 2017

Variables	Category	Cases (n=126) n (%)	Controls(n=255) n (%)
Early initiation of breastfeeding	Within one hour	82(65.1)	175(68.6)
	After one hour	44(34.9)	80(31.4)
Colostrum feeding	Yes	87(69)	217(85.1)
Prelacteal feeding*	Yes	27(21.4)	34(13.3)
Exclusively breastfeeding for the first six months	Yes	26(20.6)	107(42)
Complementary feeding material, usually (n=373)	Hand	52(41.6)	86(34.7)
	Bottle	13(10.4)	17(6.9)
	Cup /spoon	60(48)	145(58.4)
Food taboo for children**	Yes	6(4.8)	9(3.5)
Dietary diversity score of the child (CDDS) using 24 dietary recall	Low (≤3)	102(81.6)	140(56.5)
	Medium (4-5)	21(16.8)	95(38.3)
	High (≥6)	2(1.6)	13(5.2)
Minimum meal frequency	Meet	65(52)	141(56.9)
Minimum Acceptable diet (MAD)	Meet	8(6.4)	68(27.4)

*Any food (fluid, semifluid or solid) given for the child immediately after birth, **Any type of food which is strictly prohibited for children either culturally or religiously.

cases met the acceptable MDDS, while 108(43.5%) of controls met the MDDS (Table **5**).

Sanitation and Hygiene-Related Characteristics

More than half, 75(59.5%) and nearly three-fourth 189(74.1%) of study participants from cases and control groups got water from a protected source, respectively. Only 24(19%) of study participants from cases and 107(42%) from controls owned functional latrine. Around 19(15.1%) of mothers from cases and 56(22%) of mothers from control groups used soap for hand-washing. Dealing with solid waste disposal practice, 102(80.9%) from the case group and 190(75.7%) from the control group were dispose of solid waste at open filed. The rest groups use private pit and municipality for solid waste disposal.

Determinants of Childhood Stunting

At bivariable logistic regression analysis maternal education, the number of under-five children within the household, maternal BMI, maternal ANC follow-up, maternal extra meal intake during lactation, household latrine ownership, colostrum feeding, Child MDDS, Exclusively breastfeed for the first six months, birth-interval, birthplace, child age, gestational age of the index child, prelacteal feeding, vaccination status of the child, water source, and hand-washing practice of the mother were significantly associated at p-value <0.25 and transferred to the multivariable logistic regression model.

But maternal education, maternal BMI, Number of under-five children within the household, colostrum feeding, Exclusive breastfeeding for the first six months of age, DDs of children, and household ownership of latrine were statistically significant at p-value<0.05 at multivariable logistic regression model (Table **6**).

DISCUSSION

This study was intended to assess factors associated with childhood stunting among children aged 6-23 months in a pastoralist community, Afar region, Northeast Ethiopia. It was found that the odds of stunting were 66% lower among children whose mothers attended formal education than those who didn't. It is agreed with studies done in different settings of Ethiopia [20, 21], Tanzania [22], and Burundi [23]. This might be, as the mothers' educational level increases, her knowledge, attitude, and practice on childcare and feeding will improve [24]. It could be further explained by educated mothers, who might be employed and get additional income for household food security, hence lowers childhood stunting [25].

The current study also revealed that the odds of stunting were more than two and a half times higher among children from households having two or more

Table 6: Determinants of Stunting among Children Aged 6-23 Months in Golina District, Afar, Ethiopia, 2017 (n=381)

Variables/Category	Cases (n=126) n (%)	Controls (n=255) n (%)	COR (95% CI)	AOR (95% CI)	P-value
Maternal education					
Not educated	13	86	0.23(0.12, 0.42)	0.34(0.16, 0.77)	0.009
Educated	113	169	1.00	1.00	
No of under-five children within the household					
Two or more children	106	159	3.20(1.86, 5.50)	2.66(1.38, 5.10)	0.003
One child	20	96	1.00	1.00	
Maternal BMI in kg/m^2 (n=353)					
<18.5	33	40	1.95(1.14, 3.34)	2.91(1.51, 5.60)	0.003
>25	10	24	0.98(0.45, 2.17)	0.76(0.30, 1.90)	0.243
18.5-24.9	73	173	1.00	1.00	
Child age					
12-23 months	92	148	1.96(1.23, 3.12)	1.76(1.01, 3.09)	0.050
6-11 months	34	107	1.00	1.00	
Colostrum feeding					
Yes	87	217	1.00	1.00	0.001
No	39	38	2.56(1.53, 4.27)	3.03(1.62, 5.66)	
Exclusively breastfeed for the first 6 months of life					
Yes	26	107	1.00	1.00	<0.001
No	100	148	2.78(1.70, 4.61)	3.20(1.72,5.95)	
Minimum Dietary Diversity Score (MDDS)					
Meet (> 4)	23	108	0.29(0.17, 0.49)	0.41(0.22, 0.75)	0.004
Not meet (< 4)	102	140	1.00	1.00	
Functional latrine ownership					
Yes	24	107	0.32(0.19, 0.54)	0.28(0.15, 0.55)	0.006
No	102	148	1.00	1.00	

under-five children than children from households with only one under-five child. This is concurrent with studies done in Ethiopia [15] and Ghana [26]. This could be explained by, as the number of children within the household increases, there might be more competition in the available food hence leads to food insecurity within the household, which in turn leads to stunting [27].

In this study, the odds of stunting were 76% higher among children aged 12-23 months than children aged 6-11 months. It is in line with other studies done in Ethiopia [28], Ghana [29], and Burundi [23]. This might be the increment in the need for adequate complementary food as a complement to breast milk [30]. It can be further explained by as the age of the child increase their mothers might be engaged in income-generating activities, and give less time for child care [31].

The current study also revealed that the odds of stunting were nearly three times higher among children with underweight mothers than children whose mother's BMI lies within the normal range, which is consistent with the studies done in Haramaya district, Ethiopia [15], and Tanzania [32]. This notion could be explained by the importance of maternal nutritional status for the intrauterine growth of the fetus. Stunting starts in utero and mostly occurred until two years of age. Since stunting is a long-term nutritional deprivation, even though the current maternal BMI is not a direct measure of stunting, it is used as a proxy indicator of the past nutritional status of the mother [4]. The other possible reason might be an inadequate maternal diet during lactation will lead to poor secretion of nutrients in breast milk, and this can have a long-term impact on the child's height-for-age [33].

It was also found that the odds of stunting among children who were not exclusively breastfed for the first six months of life were more than three times higher compared with children exclusively breastfeed for the first six months of life. This is consistent with studies done, Ethiopia [34], Ghana [29], and Sri Lanka [35]. This might be explained by the timely initiation of appropriate complementary food is vital to supply the required nutrients for the child, and early initiation of complementary feeding has a potentially negative effect on breastfeeding frequency and duration. Also, delayed initiation of complementary food may suffer the child from inadequate energy intake since breast milk alone could not meet the need [30]. The other possible explanation might be introducing complementary foods before the age of six months might expose the infant's immature digestive system to unhygienic conditions by which to other communicable diseases [7].

This study also showed that the odds of stunting were nearly three times higher among children who didn't take colostrum compared with children who have taken colostrum. This finding is consistent with other studies done in Ethiopia [16, 36], and Turkey [37]. This might be explained by colostrum (the rich milk) contains nutrients, and antibodies to boost the child's immune system; which protects the child from infections [7, 36].

Children who were meet the MDDS had a 59 % reduced odds of stunting than children who were not meet. It is in line with studies done in Bangladesh [38], Ghana [39], and Nepal [41]. Dietary diversity is a proxy indicator of micronutrient adequacy, which has an important contribution to childhood nutritional status [40].

The odds of stunting were 72% lower among children from families owned functional latrine than children whose families not owned latrine. This is consistent with studies done in Ethiopia [28, 41], and Congo [42]. This is because latrine availability is important for hygienic conditions of the household environment. Open defecation might expose children to faecal contamination, by which to recurrent diarrheal diseases, and intestinal worms [43]. More importantly, faecal-oral contamination leads to a chronic sub-clinical condition known as environmental enteropathy, which increases the small intestines permeability to pathogens; while reducing nutrient absorption, and impaired gut immune function. This could cause stunting, even without manifesting as diarrhoea [44].

The possible limitations of this study could be: The 24-hours dietary recall method might not show the usual intake and feeding pattern of the child. Recall-bias might also be encountered. But due attention was given to minimize those limitations. Some explanatory variables such as household wealth status and food security that might have a residual confounding on stunting were not assessed.

CONCLUSION

This study found that the determinates of childhood stunting are multifactorial. The socio-demographic characteristics (maternal education, the number of under-five children within the household, and latrine ownership), maternal nutritional status (underweight) and child feeding practice (dietary diversity score of children, child age, exclusively breastfeeding for the first six months, and colostrum intakes) were found to be determinants of childhood stunting.

Thus, to improve the nutritional status of children, and avert the current trend of multi-causal childhood stunting multi-sectorial involvement and commitments are vital. The education sector has to focus on the education of girls (future mothers), and the water and sanitation (WASH) and health sector have to emphasize on creating awareness on the importance of proper latrine utilization. The nutrition and health sector should strengthen counselling services regarding maternal and child feeding practices. The agricultural sector also has to create opportunities for small-farming irrigation systems for the community, by which they might get access to diversified foods.

ABBREVIATIONS AND ACRONYMS

ANC	=	Antenatal Care
AOR	=	Adjusted Odds Ratio
BCG	=	Bacille Calmette-Guérin
CDDS	=	Child Dietary Diversity Score
CI	=	Confidence Interval
FAO	=	Food and Agricultural Organization

MDDS = Minimum Dietary Diversity Score

MMF = Minimum Meal Frequency

MUAC = Mid-Upper Arm Circumference

SD = Standard Deviation

STROBE = Strengthening the Reporting of Observational Studies in Epidemiology

UNICEF = United Nations International Emergency Fund

WASH = Water Sanitation and Hygiene

WHO = World Health Organization

AVAILABILITY OF DATA AND MATERIALS

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

ETHICAL APPROVAL AND CONSENT

The study protocol was approved by the Institutional Ethical Review Committee of Mekelle University; College of Health and Medical Science. Written informed consent was obtained from lactating mothers.

CONSENT FOR PUBLICATION

Not applicable.

COMPETING INTEREST

The authors declare that they have no conflicting interest.

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Mekelle and Samara University (funders) had no role in the study design, data collection and analysis, the decision to publish, or the preparation of the manuscript.

AUTHORS' CONTRIBUTION

GFM conceptualized and designed the study. GFM led data collection and analysis. GFM, OSA and ABB involved in the analysis, and interpretation of the result. GFM wrote the manuscript, and all the authors jointly revised the manuscript and approved the final submission of the study.

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SUPPLEMENTARY FIGURE

The supplementary figure can be downloaded from the journal website along with the article.

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