

# Predictors of chronic undernutrition (stunting) among under five children in rural east Wollega, oromiya region, west Ethiopia: a community based unmatched case - control study

## Abstract

**Background:** Chronic childhood undernutrition (stunting) becomes an underlying cause of morbidity and mortality in children as well as increasing susceptibility to different diseases later in adolescents and adults. Thus the objective of the present study was to identify predictors of chronic undernutrition among children under five years aged in rural west Ethiopia as careful understanding of these factors will help to design appropriate interventions.

**Methods:** Community based case control study was conducted on 1038 (346 cases and 692 controls) samples of children under five years aged with their respective mothers from March to July, 2016. The data was collected through interview and anthropometric measurement. Odds ratio and 95% CI (confidence interval) was estimated to identify predictors of stunting using multivariate logistic regression.

**Results:** the overall response rate was 94.5%. Stunting was significantly associated with being male children [Adjusted Odds Ratio (AOR)=2.458 95%CI=1.52, 3.99], high birth order (AOR=1.707 95%CI=1.02, 2.857), narrow birth interval (AOR=4.69 95%CI=1.613, 13.66), lack of ownership of farm land (AOR=1.698 95%CI=1.035, 2.785), open field waste disposal, diarrhea (AOR=2.44 95%CI=1.42, 4.19), short duration of breast feeding ((AOR=2.15 95%CI=1.249, 3.707) and use of bottle (AOR=2.49 95%CI=1.312, 4.725) and hand (AOR=2.39 95%CI=1.226, 4.67) for feeding of complementary foods.

**Conclusions:** Stunting was significantly associated with male sex, high birth order, narrow birth interval, lack of possession of agricultural land, poor sanitation, diarrhea, inappropriate YCF (infant and young child feeding) practices like; short duration of breast feeding and mothers utilization of bottle and hand for feeding additional foods. Thus organized efforts aimed at improving sanitary condition and YCF practices of the rural community is necessarily in order to tackle the problem of undernutrition in children. More over mothers needs to be encouraged to space births through use of family planning services.

**Keywords:** Ethiopia, east Wollega, under five children, chronic nutritional status, stunting

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**Abbreviations:** AKs, administrative kebeles; ANC, anti natal care; BF, breast feeding; CF, complementary feeding; CI, confidence interval; DHS, demographic and health survey; EMDHS, Ethiopia mini demographic and health survey; H/A, height-for-age; HAZ, height for age z score; HHs, households; YCF, infant and young child feeding; OR, odds ratio; AOR, adjusted odds ratio; SD, standard deviation; UNICEF, united nations children's fund; WHO, world health organization

## Introduction

One form of undernutrition in children is chronic undernutrition (stunting), which refers to low height-for-age, which reflects a failure to reach linear growth potential as a result of suboptimal health and/or nutritional conditions.<sup>1,2</sup>

Chronic under nutrition (stunting) is still significant public health problems mainly in least developed countries. According to previous nationwide study, the prevalence of stunting in developing countries was 38% in 2011.<sup>3</sup> In the same fashion a study found the prevalence of stunting among under five children in the horn of east Africa was 38%.<sup>4</sup>

Even if, stunting is in decreasing trend over the years, prevalence of stunting is still in serious condition in Ethiopia. According to Ethiopia Demographic and Health Survey (EDHS) 2011, 44% of Ethiopian under five children were stunted and about 40% of under five children were stunted according to mini EDHS 2014 report.<sup>5,6</sup>

In the region of the study area, according to EDHS 2011, 41.4% of under five children are stunted.<sup>5</sup> In addition mini EDHS 2014 regional report showed 38.2% of under five children were stunted, and

18.6% severely stunted.<sup>6</sup> This figure is much higher than the national as well as regional figures of wasting and underweight. As different literatures reported this highly prevalent problem becomes the causes of various morbidity and mortality conditions in under five children. For example in the horn of east Africa, it is estimated that about 5 million children die each year before reaching their fifth birthday as a result of subordinating effect of poor nutritional status on familiar communicable diseases.<sup>7</sup> Contemporaneously in Ethiopia about 10% of children die each year before reaching their first birthday due to subordinating effect of poor nutritional status.<sup>8</sup> Chronic under nutrition (stunting) has been associated with poor learning ability and low productivity, which intern had an effect on economic growth of a country. Moreover, chronic under nutrition (stunting) in childhood may be associated with adult stunting and which inter leads to have low birth weight babies thus, have an intergenerational impact.<sup>9,10</sup>

Various studies done in different area of Ethiopia showed the magnitude of chronic undernutrition but these studies do not provide sufficient evidence on those risk factors leading to chronic undernutrition. In addition previous local studies mainly try to show the association between socioeconomic and demographic factors such as family income/wealth status/, farm land, education status, family size, child's age and gender<sup>11-18</sup> with chronic under nutrition through cross sectional survey. Only few studies were reported about the association between chronic undernutrition and risk factors like Infant and Young Child Feeding (IYCF) practices which includes pre-lacteal feeding,<sup>12,14</sup> time of initiation of breast feeding,<sup>5</sup> feeding of colostrum,<sup>12</sup> duration of exclusive breast feeding,<sup>5,18</sup> duration of breast feeding,<sup>5,14</sup> age at complementary feeding,<sup>5,14</sup> the type and frequency of complementary foods<sup>14</sup> and methods of complementary feeding<sup>12,14,17</sup> as well as environmental health state like water supply, sanitation and housing conditions.<sup>11,12,15,16</sup> However, most of these surveys were conducted on insufficient number of study participants and used cross sectional study designs which are not appropriate to identify risk factors of chronic under nutrition (stunting).

Thus, the main objective of this study was to identify predictors of chronic undernutrition among children under five years aged in rural east Wollega, Oromiya region, West Ethiopia from March to July, 2016. Hence, the results of this study would help to know the contributing factors of the problem. Identifying the risk factors related with nutritional status of under five children in the study area would enable to guide public health planners and policy makers to design appropriate nutritional intervention programs to alleviate the problem and its associated consequences.

## Materials and methods

### Study design and setting

A community based case control study was employed to identify factors related to chronic nutritional status among children under five years aged in the study area by using quantitative research method. The study was conducted in East Wollega zone, west Ethiopia from March to July, 2016. East Wollega zone has a capital town of Nekemte. The town is located in western direction of Oromiya region about 328km from Addis Ababa, the capital city of Ethiopia. The zone is formed by 17 Woreda; each of the Woreda is formed from many administrative Kebeles. For majority of the population, the livelihood depends directly or indirectly on agriculture.

### Study participants and variables

The study populations was selected children under five years aged who have chronic undernutrition [Height for age < -2SD (Standard Deviation)] for cases and selected children under five years aged who have not chronically undernourished (Height for age  $\geq$  -2SD) for controls, and their corresponding mothers/care givers. The study participants (both cases and controls) were identified by investigators prior to actual data collections and households with the cases and controls are marked through code.

The sample size was calculated using, two population proportion determination formulas on Epi Info version 3.5.1 statcalc, by using the following assumptions: proportion of illiteracy among the mothers of the controls to be 66.1% and of the cases 75.0%,<sup>8</sup> 95% confidence interval, 80% power of the study, control to case ratio of 2:1 to detect an odds ratio of 1.54,<sup>15</sup> the final sample size after adding 5% non-response rate is becoming 1039 (346 cases and 692 controls).

The sampling procedures used to select representative sample was multi-stage by using simple random sampling method. Representative Woreda in the zone was selected by lottery. Next, the representative administrative Kebeles (AKs) in each selected district was selected by lottery. In the selected AKs of the districts households having under five children was identified. The names of identified HHs having under five children was coded by number. Then this HHs was selected by random number in each study AKs of the districts proportionally. Selected subjects were first assessed for stunting.

- The primary sampling unit was Woreda.
- The secondary sampling unit was Kebeles.
- The tertiary sampling unit was HHs having under five children
- The study units was individuals (mother-child pairs)

The outcome variable of this study was chronic under nutritional status (stunting status) among selected under five children. Risk factors related to poor nutritional status were observed based on UNICEF's (United Nations Children's Fund) malnutrition conceptual framework. This factors are intertwined with each other and can be grouped and put in hierarchy as immediate (biological), underlying or behavioral and basic or structural risk factors depending on their proximate contribution for the occurrences of the problem under nutrition. Accordingly the most immediate risk factors are poor diet and disease which have direct influences on child nutritional status and which are themselves influenced by a set of underlying factors; household food security, maternal/ child caring practices and access to health services and healthy environment. These underlying factors themselves are influenced by the basic factors (socio-economic and political conditions).

### Instruments and measurements

The data was collected using structured questionnaire and anthropometric measurements. The questionnaire was initially be prepared in English and then translated into the local language. Information regarding to socioeconomic and demographic factors, child factors, maternal factors and environmental health conditions was collected from mothers/caregivers by face to face interview. Anthropometric data was obtained by measuring height of children. Standing height for those who is 24months and older was measured

without any footwear to the nearest 0.1 cm using a standard calibrated bar. The height was compared with the new WHO (world health organization) child growth standards, 2006 reference data for that particular age and sex to get height for age. Children below 24 months of age (below 85 cm) were measured in a recumbent position by using a length board. In addition the correct age of a child was elicited from the child's vaccination card and mother's recall.

### Data quality assurance

Before actual data collection recruitment of educated individuals who had previous experience of data collection and who speak local languages spoken in the study area were performed. In addition one week intensive training was given to the interviewers and supervisors regarding to the objectives of the study, administration of the tool, anthropometric measurements and ethical issue. On daily basis collected information was checked for completeness and consistency by principal investigator and possible errors identified was returned to the data collectors for correction.

### Statistical analysis

Data was double entered in to Epi Data version 3.1 statistical package software and exported to Statistical Package for Social Sciences (SPSS) software version 20.0 for analysis of descriptive statistics and statistical inferences. Both bivariate and multivariate logistic regression analysis was performed to identify the factors that are associated with child chronic under nutritional status (stunting). All the variables with p value  $\leq 0.2$  at the bivariate analysis were entered into the multivariable logistic regression model. In addition, repeatedly reported risk factors of poor nutritional status were entered into the model regardless of the p-value. In multivariable logistic regression analysis OR and 95% CI was estimated to reveal the

strength of association and a "p" value less than 0.05 was used to declare the statistical significance.

### Ethical consideration

The design of this study was approved by Ethical Review Committee of Wollega University. Permission was also obtained from the concerned bodies of East Wollega Zonal Health Department and the responsible administrative bodies of selected districts and administrative Kebeles. Name and other personal identifiers were not recorded on data collection form to keep confidentiality and were also used for this study purpose only. They were given full right to leave/to refuse to take part at any stage of the interview. But their participation in this study was essential to achieving the stated objectives that cannot be achieved without the participation of them. Informed verbal consent was obtained from the participants as witnessed by data collectors name and signature.

### Results

A total of 981 children with their mothers were included and used in the analysis of this study making the overall response rate of 94.5%. Majority of studied children (224) fell in the age group 12-23 months. The mean age of cases and controls with SD were  $30.54 \pm 14.02$  and  $28.9 \pm 15.7$  respectively. Among the cases of studied children 56.1% were male and 43.9% were female. About 41.4% of mothers and 31.8% of fathers were illiterate. Illiterate mothers and fathers among cases were lower compared in controls. Almost equal proportion of mothers of cases (71.4%) and controls (70.1%) were housewife. About 67.6% of fathers of cases and 75.1% of fathers of controls were farmers. About 82% of study participants are Oromo in ethnicity (Table 1).

**Table 1** Demographic and socio-economic characteristics of the sample and their mothers in east Wollega

\*: single, divorced, widowed; \*\*: driver, daily laborer, government employee; \*\*\*: Tigre, Guragie

Variables	Coding categories	Cases (%)	Controls (%)	Total (%)
Sex of Children (n=981)	Male	194 (56.1%)	313 (49.3%)	507 (51.7%)
	Female	152 (43.9%)	322 (50.7%)	474 (48.3%)
Age of Children (n=979)	6-11	25 (7.2%)	106 (16.7%)	131 (13.4%)
	23-Dec	90 (26.0%)	134 (21.2%)	224 (22.9%)
	24-35	81 (23.4%)	121 (19.1%)	202 (20.6%)
	36-47	73 (21.1%)	138 (21.8%)	211 (21.6%)
	48-59	77 (22.3%)	134 (21.2%)	211 (21.6%)
	Mean age $\pm$ SD	$30.54 \pm 14.02$	$28.9 \pm 15.7$	$29.49 \pm 15.14$
	I	107 (30.9%)	227 (35.7%)	334 (34.0%)
Birth Order (n=981)	2-4	166 (48.0%)	316 (49.8%)	482 (49.1%)
	$\geq 5$	73 (21.1%)	92 (14.5%)	165 (16.8%)

Table continued...

Variables	Coding categories	Cases (%)	Controls (%)	Total (%)
Birth Interval (n=981)	No previous birth	107 (30.9%)	227 (35.7%)	334 (34.0%)
	<24months	51 (14.7%)	70 (11.0%)	121 (12.3%)
	>=24months	188 (54.3%)	338 (53.2%)	526 (53.6%)
Perceived Size of Baby at Birth (n=957)	Large	82 (24.6%)	151 (24.2%)	233 (24.3%)
	Average	178 (53.3%)	364 (58.4%)	542 (56.6%)
	Small	74 (22.2%)	108 (17.3%)	182 (19.0%)
Mothers Age at First Birth (n=981)	<18 years	134 (38.7%)	240 (37.8%)	374 (38.1%)
	>=18 years	212 (61.3%)	395 (62.2%)	607 (61.9%)
	<18 years	13 (3.8%)	30 (4.7%)	43 (4.4%)
Mother Age at Birth of Index Child (n=981)	18-24 years	148 (42.8%)	286 (45.0%)	434 (44.2%)
	25-31 years	120 (34.7%)	233 (36.7%)	353 (36.0%)
	>=32 years	65 (18.8%)	86 (13.5%)	151 (15.4%)
Current Marital Status (n=981)	Married	324 (93.6%)	598 (94.2%)	922 (94.0%)
	Others*	22 (6.4%)	37 (5.8%)	59 (6.0%)
Maternal Education Status (n=981)	Illiterate	138 (39.9%)	268 (42.2%)	406 (41.4%)
	Literate	208 (60.1%)	367 (57.8%)	575 (58.6%)
Paternal Education Status (n=981)	Illiterate	104 (30.1%)	208 (32.8%)	312 (31.8%)
	Literate	242 (69.9%)	427 (67.2%)	669 (68.2%)
Mother's Occupation (n=981)	Housewife	247 (71.4%)	445 (70.1%)	692 (70.5%)
	Working Mothers	99 (28.6%)	190 (29.9%)	289 (29.5%)
Mother's Husband Occupation (n=981)	Farmers	234 (67.6%)	477 (75.1%)	711 (72.5%)
	Others**	112 (32.4%)	158 (24.9%)	270 (27.5%)
	Oromo	286 (82.7%)	514 (80.9%)	800 (81.5%)
Ethnicity (n=981)	Amhara	49 (14.2%)	98 (15.4%)	147 (15.0%)
	Others***	11 (3.2%)	23 (3.6%)	34 (3.5%)
	Orthodox	151 (43.6%)	285 (44.9%)	436 (44.4%)
Religion (n=981)	Protestant	117 (33.8%)	189 (29.8%)	306 (31.2%)
	Muslim	78 (22.5%)	161 (25.4%)	239 (24.4%)

About 86 HHs are headed by female and the average family size is 4.7 persons with  $\pm 1.64$  SD and 29.1% of HHs had more than five family sizes. About 22% of HHs had 2 under five year children and 10 HHs had 3 under five year children. Majority of the study participants were living in houses having corrugated iron sheet roof and earthen floor (Table 2).

Among the frequently reported problems in cases within 2weeks preceding the study the higher proportion (47%) were diarrhea followed by fever (34%). For about 41% of studied cases the sources of drinking water were unprotected. Almost equal proportion of cases (52%) and controls (54%) had history of no colostrum feeding. Similarly for almost equal proportion of cases (84%) and controls (81%) the time of initiation of complementary foods were by the age of 4-6months (Table 3).

### Factors associated with stunting

In bivariate logistic regression analysis male children (COR=1.3

95%CI=1.009, 1.708), 5<sup>th</sup> and above birth (COR=1.68 95%CI=1.15, 2.47), narrow birth interval (<24months) (COR=4.69 95%CI=1.61, 13.66), children of mothers with no ANC follow up (COR=1.8 95%CI=1.14, 2.93), bottle feeding (COR=1.81 95%CI=1.098, 2.98), hand feeding (COR=1.64 95%CI=1.012, 2.64), breast feeding for less than 2years (COR=1.66 95%CI=1.115, 2.48), children with diarrhea (COR=1.38 95%CI=1.058, 1.796), children in female headed HHs (COR=1.76 95%CI=1.13, 2.75), HHs having more than one under five children (COR=1.49 95%CI=1.094, 2.014), children of fathers having occupation other than farmer (COR=1.45 95%CI=1.08, 1.93), children of HHs having relatively lower monthly income (COR=1.35 95%CI=1.016, 1.798) and lack of possession of agricultural land (COR=1.45 95%CI=1.089, 1.93) were more likely to be chronically undernourished. On the other hand the occurrence of stunting was about 59% less likely among children aged 6-11months compared to those older children. The odds of stunting was about 34% less likely in those children who currently breast feed compared to those under five children who currently not breast feed. The odds of stunting was

67.5% lower among children who started additional foods by the age of 4-6months and 77.5% lower in those children who started by the age of 7-12months compared to those who started by the age of <4months. The occurrence of stunting was about 46% less likely in those children of HHs who dispose waste through burning, 46.6% less likely in those HHs who dispose through composting and about 42% less likely in those HHs who dispose through collecting in pit

compared to those who dispose through open field (Table 4). In this study multivariate logistic regression analysis showed sex of children, birth order, birth interval, methods complementary feeding, duration of breast feeding, diarrhea, ownership of agricultural land and waste disposal methods were strongly significantly associated with the occurrence of stunting.

**Table 2** Demographic and socio-economic characteristics of the studied children's households

SD, standard deviation; BMI, body mass index; WC, waist circumference; AC, abdominal circumference; HC, hip circumference; RER, respiratory exchange ratio; HR, hear rate

Variables	Coding categories	Cases (%)	Controls (%)	Total (%)
Household Head (n=981)	Mothers	41 (11.8%)	45 (7.1%)	86 (8.8%)
	Fathers	305 (88.2%)	590 (92.9%)	895 (91.2%)
Family Size in a HH (n=981)	2-5	242 (69.9%)	454 (71.5%)	696 (70.9%)
	>5	104 (30.1%)	181 (28.5%)	285 (29.1%)
Number of <5 Children in a HH (n=981)	1	251 (72.5%)	506 (79.7%)	757 (77.2%)
	2-3	95 (27.5%)	129 (20.3%)	224 (22.8%)
Material of Roof of the House (n=981)	Thatched	89 (25.7%)	151 (23.8%)	240 (24.5%)
	Corrugated Iron sheet	257 (74.3%)	484 (76.2%)	741 (75.5%)
	Earthen/Soil	289 (83.5%)	497 (78.3%)	786 (80.1%)
Material of Floor of the House (n=981)	Cemented	52 (15.0%)	130 (20.5%)	182 (18.6%)
	Wooden	5 (1.4%)	8 (1.3%)	13 (1.3%)
Presence of Windows (n=981)	Yes	324 (93.6%)	602 (94.8%)	926 (94.4%)
	No	22 (6.4%)	33 (5.2%)	55 (5.6%)
Kitchen Site (n=980)	Inside Living Room	44 (12.7%)	62 (9.8%)	106 (10.8%)
	Separate	302 (87.3%)	572 (90.2%)	874 (89.2%)
Monthly HH Income (in ETB, n=884)	<=1600	126 (40.5%)	192 (33.5%)	318 (36.0%)
	>1600	185 (59.5%)	381 (66.5%)	566 (64.0%)
Decision Making on	Wife	39 (11.3%)	50 (7.9%)	89 (9.1%)
	Husband	144 (41.6%)	282 (44.5%)	426 (43.5%)
Utilization of Money (n=980)	Both Jointly	163 (47.1%)	302 (47.6%)	465 (47.4%)
	No	116 (33.5%)	164 (25.8%)	280 (28.5%)
Ownership of Agricultural Land (n=981)	Yes	230 (66.5%)	471 (74.2%)	701 (71.5%)

The odds of stunting in male children were about 2.5times higher (AOR=2.458 95%CI=1.52, 3.99) as compared to female counterparts. The risk of stunting among 5<sup>th</sup> and above birth order children were 1.71times higher (AOR=1.707 95%CI=1.02, 2.857) compared to 1<sup>st</sup> born children. The occurrence of stunting were about 5times higher in those studied children with narrow birth interval (AOR=4.69 95%CI=1.613, 13.66) and 2.4times higher in those children with 2 and above years birth interval (AOR=2.424 95%CI 1.246, 4.71) compared to those children with no previous birth. The odds of stunting were about 2.4times higher in those children whose mother uses hand (AOR=2.39 95%CI=1.226, 4.67) and cup (AOR=2.367 95%CI=1.04, 5.38) for feeding additional foods and about 2.5times higher in those children whose mother uses bottle (AOR=2.49 95%CI=1.312, 4.725) for feeding compared to those who uses spoon for feeding. Children

who had breast feed for less than 2years were 2.2times at increased risk of stunting (AOR=2.15 95%CI=1.249, 3.707) than those who breast feed for 2 and above years. Children with compliant of diarrhea within 2weeks of the study were 2.4times at increased risk of stunting (AOR=2.44 95%CI=1.42, 4.19) compared with those with no diarrheal compliant. The odds of stunting was about 2times higher in those children of HHs with no ownership of agricultural land (AOR=1.698 95%CI=1.035, 2.785) compared to those who had agricultural land. Children of HHs who dispose waste through burning, composting and in pit respectively were 51.8% (AOR=.482 95%CI=.228, 1.021), 60.1% (AOR=.399 95%CI=.223, .711) and 46.6% (AOR=.534 95%CI=.288, .99) less likely to be stunted compared to those who dispose through open field (Table 4).

**Table 3** Health and health related characteristics as well as feeding practices of the sample and their mothers  
1: river, pond, unprotected spring; 2: public tap, private pipe, protected spring

Variables	Coding categories	Cases (%)	Controls (%)	Total (%)
Diarrhea, Preceding 2wks (n=981)	Yes	164 (47.4%)	251 (39.5%)	415 (42.3%)
	No	182 (52.6%)	384 (60.5%)	566 (57.7%)
Fever, Preceding 2wks (n=870)	Yes	107 (34.2%)	182 (32.7%)	289 (33.2%)
	No	206 (65.8%)	375 (67.3%)	581 (66.8%)
Respiratory Diseases, Preceding 2wks (n=870)	Yes	52 (16.6%)	80 (14.4%)	132 (15.2%)
	No	261 (83.4%)	477 (85.6%)	738 (84.8%)
Immunization Status (n=981)	Immunized	292 (84.4%)	548 (86.3%)	840 (85.6%)
	Not Immunized	54 (15.6%)	87 (13.7%)	141 (14.4%)
Sources of Drinking Water (n=981)	Unprotected Sources1	141 (40.8%)	282 (44.4%)	423 (43.1%)
	Protected Sources2	205 (59.2%)	353 (55.6%)	558 (56.9%)
	No	106 (30.7%)	195 (30.8%)	301 (30.7%)
Presence of Latrine (n=979)	Private pit/Wooden slab	198 (57.4%)	364 (57.4%)	562 (57.4%)
	Private pit/Cement slab	41 (11.9%)	75 (11.8%)	116 (11.8%)
	Burning	78 (22.5%)	153 (24.1%)	231 (23.5%)
	Composting	162 (46.8%)	319 (50.2%)	481 (49.0%)
Waste Disposal Methods (n=981)	In pit	67 (19.4%)	122 (19.2%)	189 (19.3%)
	Open field disposal	39 (11.3%)	41 (6.5%)	80 (8.2%)
	No ANC follow up	37 (10.7%)	39 (6.1%)	76 (7.7%)
	Had ANC follow up	309 (89.3%)	596 (93.9%)	905 (92.3%)
Pre-Lacteal Feeding Practices (n=981)	No	243 (70.2%)	423 (66.6%)	666 (67.9%)
	Yes	103 (29.8%)	212 (33.4%)	315 (32.1%)
Colostrum Feeding (n=981)	No	179 (51.7%)	340 (53.5%)	519 (52.9%)
	Yes	167 (48.3%)	295 (46.5%)	462 (47.1%)
Currently BF (n=981)	>4 times	102 (29.5%)	190 (29.9%)	292 (29.8%)
	1-4 times	145 (41.9%)	307 (48.3%)	452 (46.1%)
	Not currently BF	99 (28.6%)	138 (21.7%)	237 (24.2%)
Age initiated for CF (n=760)	<4months	9 (3.3%)	5 (1.0%)	14 (1.8%)
	4-6months	229 (83.6%)	392 (80.7%)	621 (81.7%)
	7-12months	36 (13.1%)	89 (18.3%)	125 (16.4%)
Methods of CF (n=758)	Cup	85 (31.2%)	159 (32.7%)	244 (32.2%)
	Bottle	69 (25.4%)	101 (20.8%)	170 (22.4%)
	Hand	84 (30.9%)	136 (28.0%)	220 (29.0%)
	Spoon	34 (12.5%)	90 (18.5%)	124 (16.4%)
Duration of BF (n=560)	<24months	59 (28.9%)	70 (19.7%)	129 (23.0%)
	>=24months	145 (71.1%)	286 (80.3%)	431 (77.0%)
Presence of Feeding Practices during Illness (n=981)	No	159 (46.0%)	260 (40.9%)	419 (42.7%)
	Yes	187 (54.0%)	375 (59.1%)	562 (57.3%)
Hand Wash during Preparation and Feeding of Child and Herself (n=959)	Using Water only	74 (21.6%)	129 (20.9%)	203 (21.2%)
	Using Soap Sometimes	267 (77.8%)	483 (78.4%)	750 (78.2%)
	No Wash	2 (0.6%)	4 (0.6%)	6 (0.6%)

**Table 4** Factors which show association with stunting of under five children in the study area; bivariate and multivariate logistic regression analysis result  
\*: p<0.05; \*\*: p<0.005; COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval

Variables	Coding categories	Cases	Controls	COR (95%CI)	AOR (95%CI)
Sex of Children (n=981)	Male	194	313	1.3 (1.009, 1.708)*	2.458 (1.515, 3.989)**
	Female	152	322	1	1
Age of Children (n=979)	6-11	25	106	.410 (.244, .689)**	.000 (.000)
	12-23	90	134	1.169 (.794, 1.721)	1.112 (.378, 3.268)
	24-35	81	121	1.165 (.783, 1.733)	.874 (.412, 1.853)
	36-47	73	138	.921 (.618, 1.372)	.729 (.385, 1.382)
Birth Order (n=981)	48-59	77	134	1	1
	1	107	227	1	1
	4-Feb	166	316	1.114 (.828, 1.5)	1.13 (.743, 1.72)
Birth Interval (n=981)	>=5	73	92	1.68 (1.147, 2.47)*	1.707 (1.02, 2.857)*
	No Previous Birth	107	227	1	1
	<24months	51	70	1.546 (1.008, 2.37)*	4.693 (1.613, 13.655)**
Antenatal Clinic Visits (Index Child, n=981)	>=24months	188	338	1.18 (.882, 1.578)	2.424 (1.246, 4.714)*
	No ANC Follow Up	37	39	1.83 (1.143, 2.929)*	1.652 (.796, 3.428)
	Had ANC Follow Up	309	596	1	1
Currently BF (n=981)	>4 times	102	190	.748 (.526, 1.065)	.612 (.213, 1.758)
	1-4 times	145	307	.658 (.476, .911)*	.534 (.128, 2.22)
	Not currently BF	99	138	1	1
Age Initiated for CF (n=760)	<4months	9	5	1	1
	4-6months	229	392	.325 (.107, .980)*	.000 (.000)
	7-12months	36	89	.225 (.07, .717)*	.000 (.000)
Methods of CF (n=758)	Cup	85	159	1.415 (.88, 2.274)	2.367 (1.04, 5.38)*
	Bottle	69	101	1.808 (1.098, 2.98)*	2.49 (1.312, 4.725)**
	Hand	84	136	1.635 (1.012, 2.64)*	2.393 (1.226, 4.671)*
Duration of BF (n=560)	Spoon	34	90	1	1
	<24months	59	70	1.662 (1.115, 2.480)*	2.152 (1.249, 3.707)*
	>=24months	145	286	1	1
Diarrhea, Preceding 2wks (n=981)	Yes	164	251	1.379 (1.058, 1.796)*	2.441 (1.421, 4.19)**
	No	182	384	1	1
Household Head (n=981)	Mothers	41	45	1.76 (1.129, 2.75)*	1.611 (.776, 3.344)
	Fathers	305	590	1	1
	1	251	506	1	1
Number of <5 Children in a HH (n=981)	2-3	95	129	1.485 (1.094, 2.014)*	1.198 (.68, 2.108)
	Farmers	234	477	1	1
Mother's Husband Occupation (n=981)	Others**	112	158	1.445 (1.08, 1.928)*	1.104 (.616, 1.977)
	<=1600	126	192	1.352 (1.016, 1.798)*	1.084 (.572, 2.057)
Monthly HH Income (in ETB, n=884)	>1600	185	381	1	1
	No	116	164	1.448 (1.089, 1.927)*	1.698 (1.035, 2.785)*
Ownership of Agricultural Land (n=981)	Yes	230	471	1	1

Table continued...

Variables	Coding categories	Cases	Controls	COR (95%CI)	AOR (95%CI)
Waste Disposal Methods (n=981)	Burning	78	153	.536 (.32, .898)*	.482 (.228, 1.021)
	Composting	162	319	.534 (.33, .86)*	.399 (.223, .711)**
	In pit	67	122	.577 (.34, .98)*	.534 (.288, .99)*
	Open Field Disposal	39	41	1	1

## Discussion

In this study among the demographic and socioeconomic factors; being male children, higher birth order, narrow birth interval and lack of ownership of agricultural land is strongly leading to chronic under nutritional status of children.

The odds of stunting were significantly higher in male children than female counterparts which are consistent with previous studies.<sup>9-21</sup> This may be attributed to diseased status during the study period. While conducting this study compliant of diarrhea, fever, malaria and typhoid were more prevalent in male children.

The current study showed, 5<sup>th</sup> and above birth order children were at significantly increased risk of stunting compared to 1<sup>st</sup> born children. The finding is supported by previous study conducted elsewhere.<sup>22</sup> This could be explained by the fact that, those HHs with high birth order of studied children may have large family size where distribution of resources including foods and child health care is reduced. In addition cultural practice in Ethiopia in general and in the study area in particular revealed more care and attention is given for the 1<sup>st</sup> born children.

The finding of this study revealed the risk of stunting were significantly higher among those studied children born to mothers after an interval of less than 24months of his or her older children compared to those born after an interval of greater and equal to 24months of his or her older children. The finding is consistent with previous local large scale studies.<sup>23</sup> This could be explained by occurrence of pregnancy in less than two years after previous birth impacts recovery of nutritional and health status of mothers that leads to low birth weight newborn. Low birth weight infant may be at risk of experiencing growth failure during childhood and adulthood and may impact the next generation. The higher occurrence of narrow birth interval in the study area may suggest that the community had lower income as higher socioeconomic status may be related with possibility of getting improved healthcare and feeding practices as well as greater purchasing power to family planning services.

Lack of ownership of agricultural land significantly increases the risk of stunting, which is supported by previous studies conducted elsewhere.<sup>11</sup> Livelihoods of people of most of the HHs in rural areas of Ethiopia in general and in the study area in particular are depends on agriculture or cultivation of crops. Therefore land is one of the key inputs for cultivation of crops. In other words, children of HHs with farmland ownership might have higher income which is used for better living condition.

In the present study, among health and health related factors and infant and young child feeding practices; open field waste disposal, diarrhea, short duration of breast feeding and mothers utilization of bottle and hand for feeding of additional foods were strong predictors of chronic undernutrition in children.

Children of HHs which dispose wastes through open field were at increased risk of stunting. Open field waste disposal is the cause

of poor environmental sanitation and personal hygiene. When the growing children are exposed to open field wastes, they may ingest high amount of pathogens like bacteria, virus, fungi or parasites through ingestion of fingers or household materials in the oral cavity which leads to infection of intestine. This impacts nutritional status of children by; decreased appetite, reduced nutrient absorption and increased nutrient loss. Thus hygienic toilets, access to clean water and proper hand washing are key actions that need to be implemented in the study area to curb the problem of stunting.

The association between diarrhea and undernutrition is two way. That is diarrhea can cause and become consequences of undernutrition. The present study revealed children with diarrhea were at significantly increased risk of stunting compared to those without diarrhea. The finding is in line with previous studies.<sup>1,16,21</sup> This could be attributed to children with diarrhea may have reduced dietary intake, poor absorption of nutrients and increased nutrient disposal. Moreover children with undernutrition could have diminished immunity which intern leads to infection including diarrhea.

Breast feeding helps to ensure normal health of children as it provides the right balance of nutrients. The present study come with breast feeding for less than 24months significantly increases the risk of stunting. This could be due to lack of essential nutrients and antibodies gained from the breast milk. Antibodies obtained from the breast feeding protect against different diseases mainly diarrhea and respiratory infections which leads to diminished appetite and thereby decreased intake of foods. In addition in the presence of short duration of breast feeding there is poor psychomotor, emotional and social development of the child due to inadequate skin to skin contact between the mother and the child.

That is skin to skin contact encouraged by breast feeding offer the chance for babies to develop greater emotional security and to enhance bonding. In contrary previous local study conducted elsewhere<sup>14</sup> reported prolonged duration of breast feeding significantly increases the risk of stunting. This may be attributed to inappropriate complementary feeding practices of the previous study area. That is time of initiation of complementary feeding among the previous children may be in older age. Thus to enhance good nutritional status of children both larger duration of breast feeding and appropriate complementary feeding is necessarily.

Children of mothers who use bottle and hand for feeding of complementary foods were at significantly higher risk of stunting which is consistent with previous many local studies.<sup>12,14,17</sup> This could be attributed to high chance of contamination with pathogens and ingestion of microorganisms along with the food eaten which intern leads to infection and undernutrition.

In the present study maternal educational status didn't show significant association with chronic nutritional status of children, which is in line with previous local study.<sup>13</sup> On the other hand the finding of this study is in contrary to the result of many other previous studies conducted elsewhere.<sup>12,19,21,22,24</sup>

This study might have the following limitations. As the study was questionnaire based, questions that required a good memory were vulnerable to recall bias. In addition because of interview nature of the study, it could offer a chance for interviewer bias. Lastly, the study is predisposed to errors of anthropometric measurement that might lead to misclassification of children's nutritional status. However necessary efforts were made on study procedures which include, intensive training of research team, repeated measurement and close supervision of the data collectors during the field work to decrease anthropometric measurement errors. In addition efforts were made to get correct age of the children like looking of child's vaccination card or discharge delivery card and mother's recall. Mother's recall especially recall of illiterate mother was assisted by referring to local events.

## Conclusion and recommendations

Stunting was significantly associated with male sex, high birth order, narrow birth interval, lack of possession of agricultural land, poor sanitation, diarrhea, inappropriate IYCF (infant and young child feeding) practices like; short duration of breast feeding and mothers utilization of bottle and hand for feeding additional foods. Thus organized efforts aimed at improving sanitary condition and IYCF practices of the rural community is necessarily in order to tackle the problem of undernutrition in children. More over mothers needs to be encouraged to space births through use of family planning services.

## Declaration

### Ethical consideration

The design of this study was approved by Ethical Review Committee of Wollega University. Permission was also obtained from the concerned bodies of East Wollega Zonal Health Department and the responsible administrative bodies of selected districts and administrative Kebeles. Name and other personal identifiers were not recorded on data collection form to keep confidentiality and were also used for this study purpose only. They were given full right to leave/to refuse to take part at any stage of the interview. But their participation in this study was essential to achieving the stated objectives that cannot be achieved without the participation of them. Informed verbal consent was obtained from the participants as witnessed by data collectors name and signature.

## Consent for publication

Not applicable

## Availability of data and materials

The corresponding author may provide if necessarily

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## Authors' contribution

AT: principal investigator involved in conception and designing of the study, collection, entry, analysis, interpretation of the data, prepare the manuscript.

MC: involved in designing of the study, analysis and interpretation of data as well as manuscript preparation.

EA: involved in designing of the study, analysis and interpretation of data as well as manuscript preparation.

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## Conflict of interest

The author declares no conflict of interest.

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