

1 ***Determinants of Severe Acute Malnutrition among Children age 6-59 Months Old in Two***  
2 ***Public Hospitals, North West Ethiopia: a Case Control Study***

3 Adonia Damtew Nebro<sup>1</sup> \*      Degnet Teferi Asres<sup>1</sup>      Reddy PCJ Prasad<sup>1</sup>

4 <sup>1</sup>Department of Applied Human Nutrition, Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar, Ethiopia

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\* Corresponding author  
adoniadamtew@gmail.com (AD)

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45 **Abstract**

46 **Introduction:** Globally severe acute malnutrition affects 16.4 million under five children and  
47 more than one quarter of those children live in Africa. In Ethiopia, about 3% of children are  
48 severely wasted and continues to be persistent over the past 15 years. To implement an effective  
49 intervention, it is essential to identify predictors predispose to it. This study therefore, aimed to  
50 identify determinants of severe acute malnutrition among under five children in selected public  
51 health facilities, Northwest Ethiopia.

52 **Methods:** Institution based; age matched case control study was conducted on 104 cases and  
53 208 controls. Bivariate and multivariate analyses were done using conditional logistic  
54 regression to identify predictors. Variables having  $P$ -value  $\leq 0.2$  during binary analysis were  
55 entered into multivariate analysis.  $P$  value  $< 0.05$  was considered as statistically significant.

56 **Results:** Children from households of large family size (AOR=2.7, 95% CI: 1.06 – 6.9), having  
57 monthly income less than 1500 birr (AOR = 5.17, 95% CI: 1.7 -15.3), which are food insecure  
58 (AOR = 2.9, 95% CI:1.17-7.28) , which didn't receive any nutrition information (AOR=  
59 3.47,95% CI: 1.14 - 7.10), didn't practice exclusive breastfeeding (AOR = 2.69, 95% CI : 1.18  
60 - 6.10), and practice infrequent hand washing (AOR= 7.6 95% CI:2.44- 23.6) as well as children  
61 who had history of diarrhea two weeks prior to the survey (AOR 3.2 ,95%CI:1.4 -7.2) were more  
62 likely to suffer from severe acute malnutrition.

63 **Conclusion:** Family size, monthly income, food security status, exclusive breastfeeding practice,  
64 access to information on child feeding, hand washing practice and history of diarrhea were  
65 identified to be predictors of severe acute malnutrition. Due emphasis should be given to  
66 promoting family planning, improve household livelihoods and food security, strength  
67 awareness creation on exclusive breastfeeding and frequent hand washing practices as well as  
68 prevention of diarrhea.

69 **1. Introduction**

70 Severe acute malnutrition is defined as severe wasting (low weight for height) and/or mid-  
71 upper arm circumference (MUAC)<115 mm and/or bilateral pitting oedema (1).

72 Globally wasting is threaten the lives of 50.5 million under 5 children. Among this 16.4  
73 million Children were severely wasted. Africa is the home of 13.8 million wasted children  
74 from which sever acute malnutrition threats the lives of 4 million children. At the same time  
75 the eastern Africa shares the burden of 1.5 million severely wasted children (2).

76 Children suffering from wasting an increased risk of death. Worldwide from 11.5% of the  
77 death occurred in children due to acute malnutrition 7.8% of the child death was attributed  
78 to sever acute malnutrition (3).

79 Despite the fact that the government of Ethiopia strives to increase its effort to enhance good  
80 nutritional practices through different programs, the poor nutritional status of children and  
81 women continues to be a serious problem. There has been a substantial decline in the  
82 proportion of children stunted and underweight. However, the proportion of wasted children  
83 remaining persistent overtime (4). According to the 2016 Ethiopian demographic & health  
84 survey report, 3 % of under five children are severely wasted. (5)

85 Similarly; Amhara region is among the highly affected region by malnutrition in Ethiopia.  
86 The proportions of children who are wasted and severely wasted were 9. 8% and 2.2%  
87 respectively (5). Higher prevalence of sever acute malnutrition (7.9%) were reported from a  
88 study done at Northwest Ethiopia(6). This indicates SAM is a serious public health problem  
89 in North West Ethiopia.

90 Study conducted in deferent part of the world shows that the predicators of acute malnutrition  
91 were inadequate care for children like poor infant and young child feeding, household food  
92 insecurity (7–9) incomplete/lack of immunization (10,11). poor environmental health  
93 condition (inadequate and unsafe water supply, and poor environmental sanitation) and  
94 mothers habit of less frequent hand washing and absence of latrine (7).

95 Though acute malnutrition is one of the public health problems and persistent over time in  
96 Ethiopia particularly in the study area, available studies on the determinants of SAM are  
97 limited. To implement an effective and efficient intervention, which can reduce the high  
98 burden of sever acute malnutrition, it is essential to understand factors predisposing to it in  
99 different part of the country. Therefore, this study is intended to assess the determinant  
100 factors of SAM in under five children in North West Ethiopia.

## 101 **Objective**

102 ➤ To identify predictors of severe acute malnutrition among children of 6-59 months of  
103 age in Felege Hiwot and Debre Tabor referral hospitals, Northwest Ethiopia.

## 104 **Methods**

### 105 **Study design, period and setting**

106 Institution based case control study design was employed from February 15, 2017 to June,  
107 10 2017 at Felege Hiwot and Debre Tabor referal hospitals, Northwest Ethiopia. Felege  
108 Hiwot referral hospital is located in Bahir Dar. Bahir Dar (capital city of Amhara Regional  
109 State) and it is 565 km far to Northwest of Addis Ababa. It serves over 7 million people

110 from the surrounding area. Debre Tabor referral hospital located in South Gondar zone of the  
111 Amhara Region of Ethiopia( Debre Tabor town) which is about 100 kilometers southeast  
112 of Gondar and 50 kilometers east of Lake Tana. It provides services for 2.3- 2.5 million  
113 people of the surrounding area.

#### 114 **Source and study population**

115 All children 6–59 months of age with SAM or without malnutrition that have been admitted  
116 and treated at therapeutic feeding units (TFU) and/or other pediatric units of the two hospitals  
117 were the source population. The study population were 312 children age 6-59 months who  
118 were selected for this study from both hospitals during the study period.

#### 119 **Inclusion and exclusion criteria**

120 Children in the age of 6-59 months who were admitted in the two hospitals due to severe  
121 acute malnutrition with their care takers/mothers were included into the study as cases.

122 Children aged 6-59 months with normal nutritional status and who had visited pediatrics  
123 units for different health care services during the study period were included as controls.

124 Children in the age of 6-59 months with disability (physical deformity and handicapped) and  
125 children who had sudden shock (unconscious) during the study period were excluded.

126 Children with secondary undernutrition due to other pathological disorders and with other  
127 causes of edema were also excluded.

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### 130 **Sample size and sampling procedure**

131 The sample size was calculated using two population proportion formula, by taking maternal  
132 autonomy in decision making as major associated factor from other study and proportion of  
133 mother who had no autonomy in decision making to be 85.2% among cases and 69.4%  
134 among controls and detecting OR of 2.545 (12), with 95% CI, a power of 80%, a two to one  
135 ratio of control to case (2:1) and 10% non-response rate. By referring the above, the sample  
136 size was 276 (92case and 184 controls). But 104 cases and 208 controls were included  
137 assuming it could increase the power of the study.

138 The sample size was proportionally allocated to the two hospitals based on the average  
139 monthly follow rate of under five Children with severe acute malnutrition. Out of the total  
140 sample, 66 cases and 132 controls were allocated to Felege Hiwot referral hospital, while 38  
141 cases and 76 controls were allocated to Debre Tabor referral hospital. Children in the age of  
142 6-59 months admitted due to SAM in the therapeutic feeding units of the two hospitals during  
143 the study period were included until the calculated sample size was saturated. The controls  
144 were match to the case within  $\pm 2$  months. Once a case child was admitted, his/her  
145 mother/caretaker was interviewed immediately and then the first two controls matched with  
146 one case of a similar age in months were randomly selected immediately after the admission  
147 of a case.

### 148 **Data collection and quality assurance procedures**

149 The data were collected from all study participants using interviewer administered structured  
150 questionnaire. The questionnaires were originally prepared in English and then translated to

151 local language, Amharic and translated back to English language to check consistency. The  
152 questionnaire comprised of different variables including socio-economic and demographic  
153 factors, child caring practices (feeding practice, immunization), household food security  
154 status and environmental health conditions.

155 Household food insecurity was assessed by using the nine standard Household Food  
156 Insecurity Access Scale (HFIAS) questionnaire developed by the Food and Nutrition  
157 Technical Assistance (FANTA) (13).

158 Dietary diversity scores (DDSs) were estimated via a 24-h recall method using the seven  
159 food groups. The food groups assessed were; Grains, roots or tubers; Vitamin A-rich fruit  
160 and vegetables; other fruits and vegetables; Flesh foods (Meat, poultry, fish and seafood);  
161 Eggs; Legumes, Pulses or nuts; milk and milk products (14).

162 In order to select the controls, weights of the children were measured in kg to the nearest 0.1  
163 kg with minimum clothing and the height in (cm) to the nearest 0.1 cm. MUAC of the  
164 children were measured in cm to the nearest 0.1 mm and presence of bilateral pitting edema  
165 was checked by applying thumb pressure on both feet of the child. After all these above  
166 anthropometric measurements, if children were found to normal in nutritional status they  
167 were included as controls.

168 To assure the quality of the data, properly designed, pretested questionnaire was used.  
169 Training was given for data collectors and supervisor for two days.

170 **Variable Definitions**

171 **Cases:** children with severe acute malnutrition whose MUAC $\leq$ 11.5cm, WHZ < -3 SD or  
172 with bilateral pitting oedema.

173 **Controls:** children with normal nutritional (without edema or their MUAC >12.5 cm, their  
174 WHZ >-2 SD).

175 **Diet diversity:** - A child with a DDS of less than four was classified as having poor dietary  
176 diversity; or else, it was considered to have good dietary diversity.

177 **Household food security status ((13))**

178 ➤ Food secure - Household experiences none of the food insecurity conditions, or just  
179 experiences worry, but rarely

180 ➤ Food insecurity - If household worries about not having enough food sometimes or  
181 often and or experiences other food insecurity conditions

182 **Data Processing and Analysis**

183 Data were coded and entered to EPI info version 7.0 and transferred to Stata 14.0 for analysis.  
184 Frequencies and cross tabulation were calculated to describe the study population in relation  
185 to relevant variables. Conditional logistic regression was used to fit the data to identify the  
186 predictors for SAM. Both bivariate and multivariate logistic regression was computed to  
187 identify the determinants of severe acute malnutrition. Variables which had p-value of  $\leq 0.2$   
188 in the bivariate analyses were entered in to multivariate analysis. P values < 0.05 were  
189 considered to declare the statistical significance.

190 **Ethical consideration**

191 Ethical clearance was obtained from Review committee of Faculty of Chemical and Food  
192 Engineering, Bahir Dar Institute of Technology. The regional health bureau ethical review  
193 board approved and gave formal letter to both hospitals. Permissions to collect the data were  
194 obtained from medical directors of the two hospitals. Informed consent was obtained from  
195 the parents<sup>7</sup>/care givers of the children prior to taking necessary data.

196 **Results**

197 **Socio-demographic characteristics of the Study subjects**

198 A total of 312 (104 cases and 208 controls) participated with response rate of 100%. The  
199 mean age of the cases in months was 17.8(SD ± 11.51) and it was 17.62 (SD ± 10.88) among  
200 the controls. The mean age of the mothers of cases and controls in years were 31.9(SD ±  
201 6.04) and 30.01(SD ± 5.45) respectively. Regarding the sex of the children almost half  
202 (52.95%) of the cases and 54.8% of controls were male. About 64.4% of households of the  
203 cases and 46.6% of controls had the family size of > 4. Families of the cases who had monthly  
204 income of <1500 birr were 69.2% while the families of controls who had monthly income  
205 <1500 birr were 21.1% (Table 1).

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209 Table 1: Socio-demographic and economic characteristics of the study participants in Felege  
210 Hiwot and Debre Tabor referral hospitals, February-June 2017

Variables		Case n (%)	Control n (%)
Religion	Orthodox	89(88.6)	186(89.4)
	Muslim	15(14.4)	22(10.6)
Age of the respondent	15-34	71(68.3)	180(76)
	35-58	33(31.7)	50(24)
Residence	Urban	32(30.8)	123(59.1)
	Rural	72(69.2)	85(40.9)
Head of household	Male headed	96(92.3)	201(96.6)
	Female headed	8(7.7)	7(3.4)
Marital status	Married	96(92.3)	202(97.1)
	Other	7(6.7)	3(1.4)
Maternal education	No formal education	77(74.0)	97(46.6)
	Formal education	27 (26)	111 (53.4)
Paternal education	No formal education	67(69)	77(37.5)
	Formal education	28(28.86)	129(62.9)
Paternal occupation	Government employ	7(7.2%)	60(29.3)
	Farmer	66(68.0%)	83(40.5)
	Merchant	16(16.5%)	46(22.4)
	daily laborer	8(8.2%)	16(7.8)
Maternal occupation	Employed	6(5.8)	41(19.7)
	Housewife	24(23.1)	55(26.4)
	Farmer	60(57.7)	77(37.0)
	Merchant	14(13.5)	35(16.8)
Monthly income (Birr)	<1500	72(69.2)	44(21.1)
	≥1500	32(31.8)	164(78.9)
Decision making to use money	Mostly mother	20(19.2)	25(12)
	Mostly father	61(58.7)	93(44.7)
	Jointly	23(22.1)	90(43.3)
Family size	<5	37(35.6)	111(53.4)
	≥5	67(64.4)	97(46.6)
Birth order	<3	44(42.41)	118(56.7)
	>3	60(57.69)	90(43.3)
Under five children	One	80(76.9)	156(75.0)
	Two	24(23.1)	52(25.0)
Sex of the child	Male	55(52.9)	114(54.8)
	Female	49(47.1)	94(45.2)
Child Mean age in months (±SD)		17.81(SD±11.5)	17.62(SD±10.8)
Food security status	Food insecure	66(63.5)	44(22.6)
	Food secure	38(36.5)	161(77.4)

211 **Maternal and child caring practices**

212 High proportions of the cases (64.4%) were not exclusively breastfed for the first 6 months of age

213 compared to the controls (35.5%). About 64.42% of the cases and 23.1% of the controls had diarrhea

214 to two weeks prior to the survey. Majority (95.1%) of mothers /caretakers of the cases and 87.1% of  
 215 mothers/caretakers of the controls used to take their children to health facilities after 24 hour of the  
 216 onset of diseases. About 87.65% of mothers/caretakers of the cases and 77.03% of  
 217 mothers/caretakers of the controls didn't give additional food when the children were sick (Table 2).

218 Table 2, Maternal and child caring practice of respondents at Felege Hiwot and Debre Tabor  
 219 Hospitals, February – June 2017, n=312

Variables		Case No (%)	Control No (%)
Exclusive breast feeding	<b>Yes</b>	37(35.5)	129(62.2)
	<b>No</b>	67(64.5)	79(37.8)
Dietary diversity score	<b>&lt; 4 food groups</b>	64(61.5)	63(30.7)
	<b>≥ 4 food groups</b>	40(39.5)	145(69.3)
Age appropriate immunization	<b>Yes</b>	96(92.3)	202(98.7)
	<b>No</b>	8(7.6)	6(2.3)
Child vitamin-A supplementation in the past six months	<b>Yes</b>	58(49.3)	151(47.9)
	<b>No</b>	46(50.7)	57(52.1)
History of diarrheal in the previous two weeks the survey	<b>Yes</b>	67(64.42)	48(23.07)
	<b>No</b>	37(35.58)	160(76.9)
History of fever in the past two weeks	<b>Yes</b>	54(51.9%)	106(51%)
	<b>No</b>	50(48.1)	102(49%)
Take to health institution when the child is sick	<b>Within 24 hr</b>	4(4.9%)	19(12.9%)
	<b>After 24 hr</b>	77(95.1%)	129(87.1%)
Nutrition information on child feeding	<b>Yes</b>	51(49)	172(82.69)
	<b>No</b>	53(51)	36(17.31)
Place of delivery	<b>Home</b>	24 (23)	25(12.1)
	<b>Health institutions</b>	80(77)	183(87.9)
ANC	<b>Yes</b>	90(88.23)	197(97.6)
	<b>No</b>	12(11.77)	11(2.4)
Give additional food to seek child	<b>Yes</b>	10(12.35)	34(12.97)
	<b>No</b>	71(87.65)	114(77.03)

## 220 Environmental health conditions

221 The families who had access to protected water source were 54.8% in the cases and 76.4% in the  
 222 controls. Almost all households (97.1%) of the cases and 97.65% of the controls didn't treat water  
 223 at home. Frequent hand washing practice (before serving/preparing food, after defecation before  
 224 feeding the child) was practiced in 61.5% of the mothers/caretakers of the cases and 89.4% of  
 225 controls. Mothers who used to wash their hands using water only were 54.8% in cases and 31.2% in  
 226 controls (Table3).

227 Table 3: Environmental health conditions of the respondents in Felege Hiwot and Debre  
 228 Tabor Hospitals, February-June, 2017 n=312

Variables		Case No (%)	Control No (%)
Source of water	Protected	57(54.8)	159(76.4)
	Unprotected	47(50.7)	49(23.7)
Water treatment at home	Yes	3(2.9)	5(2.4%)
	No	101(97.1)	203(97.6)
Waste disposals	Appropriate	38(36.5)	154(74.03)
	Inappropriate	66(63.5)	54(25.7)
Hand washing practice of mothers/ caregivers	Wash frequently	64(61.5)	106(89.4)
	Wash less frequently /not wash	40(38.5)	22(10.6)
Use of detergents or local cleansing gents	water Only	57(54.8)	65(31.2)
	Sometimes with soap	41(39.4)	95(45.7)
	Always using soap	6(5.8)	48(23.1)
Toilet facility	Yes	60(57.69)	183(87.98)
	No	44(42.31)	25(12.12)

229 **Determinants of sever acute malnutrition**

230 The socio-demographic and economic characteristics that were significant predictors of  
 231 SAM in the multivariable analysis include monthly income, family size, and household food  
 232 security status. Furthermore, exclusive breastfeeding practice, access to information on  
 233 child feeding and history of diarrhea two weeks prior to the survey and hand washing  
 234 practice were also significant determinants.

235 Children from households with large family size (>5) were 2.7 times more likely to be  
 236 affected by SAM as compared to their counterparts (AOR=2.7, (95% CI: 1.06 – 6.9).  
 237 Children from families who had monthly income of < 1500 birr were nearly 5 times more  
 238 likely to develop severe acute malnutrition as compared to children from families with  
 239 monthly income of  $\geq 1500$  (AOR = 5.17 ,95% CI:1.7 -15.3). Children from food insecure  
 240 household were also about 3 times more likely develop SAM as compared to their  
 241 counterparts (AOR= 2.9, 95% CI: 1.17-7.28).

242 The odd of SAM was higher among children who were not exclusively breastfed compared  
243 to exclusively breastfed children (AOR = 2.69, 95% CI: 1.18- 6.10). Children from  
244 mothers/care givers who didn't receive nutrition information were 3.4 times more likely to  
245 be severely malnourished than their counterparts (AOR=3.47, 95% CI: 1.14 -7.10).

246 Children whose mothers/care takers didn't practice frequent hand washing were 7.6 times  
247 more likely to be affected by SAM than those who did (AOR 7.6, 95% CI: 2.44- 23.6).  
248 Similarly, children who had history of diarrhea two weeks prior to the survey were about  
249 3 times more likely to develop SAM as compared to their counterparts (AOR 3.2,95%CI:1.4  
250 -7.2)(Table 6).

Table 6. Both bivariate and multivariable resulted of determinants of sever acute malnutrition in Felege Hiwot and Debre Tabor Hospitals, February-June, 2017 (n=312)

Variable		Case No (%)	Control No (%)	Crude OR			Adjusted OR		
				OR	95% CI	P-value	OR	95% CI	P-value
Residence	Urban	32(30.8)	123(59.1)	1			1		
	Rural	72(69.2)	85(40.9)	3.48	2.03-5.97	0.000	1.56	.328-7.42	0.567
Maternal education	No formal education	77(74.0)	97(46.6)	3.47	1.98 -6.08	.000	.79	.204-3.07	0.736
	Formal education	27 (26)	111 (53.4)	1			1		
Paternal education	No formal education	67(69.07)	77(37.1)	4.5	2.51-8.11	.000	2.5	.638 - 9.88	0.187
	Formal education	28(28.86)	129(62.9)	1			1		
Paternal occupation	Government employ	7(7.2%)	60(29.3)	1			1		
	Farmer	66(68.0%)	83(40.5)	6.73	2.72-16.65	0.000	.89	.107- 7.35	0.914
	Merchant	16(16.5)	46(22.4)	2.57	.92 - 7.17	0.072	3.8	.729-20.32	1.56
	daily laborer	8(8.2%)	16(7.8)	4.92	1.45 -16.74	0.011	2.8	0.31-25.66	0.93
Maternal occupation	Employed	6(5.8)	41(19.7)	1			1		
	Housewife	24(23.1)	55(26.4)	2.83	1.06 -7.56	0.038	.44	.072 - 2.74	0.384
	Farmer	60(57.7)	77(37.0)	5.46	2.14 - 13.93	0.000	.20	.022 - 1.76	0.148
	Merchant	14(13.5)	35(16.8)	2.56	0.88 -7.42	0.083	.48	0.59 - 3.85	0.491
Monthly income(Birr)	<1500	72(69.2)	44(21.1)	11.89	5.62-25.13	0.000	5.17	1.74 -15.3	0.003
	>=1500	32(31.8)	164(78.9)	1			1		
Decision making to use money	Mostly mother	20(19.2)	25(12)	4.31	1.83 10.17	.001	.610	.165-2.25	0.459
	Mostly father	61(58.7)	93(44.7)	2.79	1.54-5.04	.001	.472	.108-1.69	.226
	Jointly	23(22.1)	90(43.3)	1			1		
Family size	<5	37(35.6)	111(53.4)	1					
	≥5	67(64.4)	97(46.6)	1.92	1.14-3.24	0.014	2.7	1.06-6.93	0.036
Food security status	Food insecure	66(63.5)	44(22.6)	7.24	3.85-13.61	.000	2.9	1.17-7.28	0.021
	Food secure	38(36.5)	161(77.4)	1			1		
Exclusive breast feeding	Yes	37(35.5)	129(62.2)	1			1		
	No	67(64.5)	79(37.8)	3.5	2.04-6.11	.000	2.6	1.18-6.10	0.018
Dietary diversity score	< 4 food groups	64(61.5)	63(30.7)	4.18	2.13-6.33	0.00	1.32	0.488-3.61	0.56
	≥ 4 food groups	40(39.5)	145(69.3)	1			1		
History of diarrheal in the previous two weeks	Yes	67(64.42)	48(21.58)	4.57	2.70 - 7.35	.000	3.2	1.40-7.28	0.006
	No	37(35.58)	159(78.42)				1		

Continued...									
Child vitamin-A supplementation	Yes	58(49.3)	151(47.9)	1			1		
	No	46(50.7)	57(52.1)	2.50	1.44-4.47	0.001	1.19	.44-3.26	0.72
Place of delivery	Home	24 (23)	25(12.1)	2.4	.1.26-4.69	0.000	.77	2.57-.230	.641
	Health institutions	80(77)	183(87.9)	1			1		
Nutrition information on child feeding	Yes	51(49)	172(82.69)	1			1		
	No	53(51)	36(17.31)	5.7	3.22-10.13	0.000	3.4	1.5-7.9	0.003
Source of water	Protected	57(54.8)	159(76.4)	1			1		
	Unprotected	47(50.7)	49(23.7)	2.74	1.62-4.63	0.000	.345	.109-1.08	.070
Waste disposals	Burning /pit	38(36.5)	154(74.03)	1			1		
	Open field	66(63.5)	54(25.7)	5.9	3.25-10.74	0.000	1.46	.513-4.00	0.492
Hand washing practice of mothers	Wash frequently	64(61.5)	106(89.4)	1			1		
	Wash less frequently/not wash	40(38.5)	22(10.6)	5.5	2.89-10.74	0.000	7.6	2.44-23.6	0.000
Use of detergents or local cleansing agents	Water only	57(54.8)	65(31.5)	9.3	3.14-27.55	0.000	1.38	0.28- 4.49	0.658
	Sometimes with soap	41(39.4)	95(45.6)	4.35	1.42-13.32	0.010	1.8	.537-6.85	0.383
	Always using soap	6(5.7)	48(22.9)	1			1		
Toilet facility									
Yes		60(57.69)	183(87.98)	1			1		
No		44(42.31)	25(12.12)	5.55	2.96-10.42	0.000	2.71	1.06 – 6.93	2.10

## Discussion

Factors contributing to SAM are multifaceted and identifying the determinants of SAM in the study area can be very important to implement effective intervention. In this study, the determinants identified for SAM were family size, monthly income, household food security status, exclusive breastfeeding practice, hand washing practice and diarrhea history two weeks prior to the survey.

Accordingly, children from households with large family size ( $>5$ ) were 2.7 times more likely to be affected by SAM as compared to children from household with smaller family size. The finding was in line with a study done in Sudan, which revealed that having more than four family members in the household was associated with acute malnutrition (15). This might be because of the fact that increased number of families placed a heavy burden on scarce household resources, particularly on financial and food. That might make difficult to fulfill the dietary need of the children. Besides, the increased number of family might reduce the time and quality of care received by the children.

Children from families who had monthly income of less than 1500 birr were nearly 5 times more likely to develop SAM as compared to children from families who had monthly income of 1500 birr and above. This finding was comparable with the study conducted in Jimma Zone, Ethiopia; which points out that children whose family monthly income of less than \$50(1450 Ethiopian Birr) were 6 times more likely to be affected by SAM (16). This can be explained by the fact that households with low income could not afford to buy food for consumption which results in inadequate diet that leads to child malnutrition.

The odd of severe acute malnutrition in children increased when the household was food insecure. Children from food insecure households were 3.7 times more likely to be affected by SAM than children whose families were food secured. This is consistent with a study done in west Gojjam,

Northwest Ethiopia (17) and Haromaya District ,Eastern Ethiopia (18). In contrary, a study from Gambela town, Western Ethiopia and Sekela District , Western Ethiopia revealed that there was no significant association between household food insecurity and acute malnutrition in children aged under 5 years(19,20) . In this study, household food insecurity was found to be significant determinant of SAM and this might be due to limited availability of food or no economic access to purchase it which might lead to reduced quantity and quality of diet. Therefore, food insecure households might not satisfy the dietary need of household member, especially those under five children because they are at greater risk of malnutrition due to their higher nutrient demand for their growth. (21,22)

In this study exclusive breastfeeding practice was one of the determinants of SAM among children. Children who were not exclusively breastfed were nearly 4 times more likely to suffer from SAM. Similar findings were also documented in other studies done in Oromia Region and East rural Ethiopia (7,23). The study done in EAG States, India also indicated that children who were exclusively breastfed were found to be 16 percent less likely to be mild wasted and 48 percent less likely to be not wasted (24). This could be explained by the fact that children who were not exclusively breastfed had lower chance of preventing infections as breast milk has many immunological properties that are likely to protect against infections in infancy. A study done in Tanzania confirmed that exclusive breastfeeding reduce the risk of diarrhea dysentery(25). Besides, there might be contamination of bottles and foods that were early introduced to the child which contributes to higher risk of diarrheal disease in children.

Access to nutritional information on child feeding practice was also another determinant of SAM identified in this study. Children whose mothers/caretakers didn't have any nutrition information on child feeding practice were nearly 3 times more likely to develop SAM than those children whose mothers/caretakers had information on child feeding practice. This finding is also supported

by other study which is done in Botswana (26). Lack of information on child feeding might lead to inappropriate child feeding practice which then could affect the nutritional status of the children.

Hand washing practice was another factor that was found to be a significant determinant of SAM. Children whose mothers didn't wash their hands before serving food, after defecation, before feeding the child and after cleaning the child were 7 times more likely to develop SAM as compared to children whose mothers washed their hands in each activity. Similar findings were documented in studies conducted in Oromia region, West Ethiopia and Machakel district, Northwest Ethiopia (7,27). This might be due to the fact that poor hand washing practice might lead to contamination of foods and that might increase a risk of infections and diarrheal diseases that in turn might lead to poor appetite and poor absorption of nutrient and finally might expose the child to SAM.

Moreover, history of the diarrhea two weeks prior to the survey was identified to be significant predictor for occurrence of SAM. The odd of SAM increased by three fold in children who had diarrheal disease two weeks prior to the survey than those who didn't. Similar findings were reported from studies conducted in Shashogo, southern Ethiopia and Oromia, West Ethiopia (7,12). This could be due to the fact that diarrheal disease might lead to loss of appetite, loss of nutrients from the body and poor absorption of nutrients consumed.

**Limitations of the study:** Since the questions were relied on the memory of the mothers/ caretakers, this might introduce recall bias. To minimize this bias the recalling period was made shorter for some variables like history of diarrhea within two weeks prior to survey and about food consumption during last 24 hours which is a reasonable recalling period. However, for some of the variables like exclusive breastfeeding practice and vaccination received might introduce recall bias. There might be also selection bias because controls were selected from health facilities.

## **Conclusion**

The findings of this study confirmed that family size, monthly income, food security status , exclusive breastfeeding practice, access to information on child feeding, history of diarrhea two weeks prior to the survey and hand washing practice were significant determinants of severe acute malnutrition . due attention should be given to improve the knowledge and practice of parents towards exclusive breastfeeding and family planning by integrate breastfeeding promotion and support throughout the maternal and child health continuum, particularly in the prenatal and postpartum periods. It is also important to strengthen prevention and control of diarrheal disease through promotion of good hygiene (hand washing) and exclusive breastfeeding practices in the community. Creating income generating activities to improve the income and food security status of the poor households is also highly recommended. Since determinants of SAM were identified to be multifaceted and it cannot be addressed by a single sector only, the government should build strong multi-sectorial collaboration (Health, WASH and Agricultural sectors) to address the problem of severe acute malnutrition.

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## References

1. World Health Organization UNCF. WHO child growth standards and the identification of severe acute malnutrition in infants and children. A Joint Statement. 2009;
2. UNICEF/WHO/World Bank Group. LEVELS AND TRENDS IN CHILD MALNUTRITION. Joint Child Malnutrition Estimates 2018 edition. 2018;
3. Black RE, Allen LH, Bhutta ZA, Caulfield LE, Onis M De, Ezzati M, et al. Series Maternal and Child Undernutrition 1 Maternal and child undernutrition : global and regional exposures and health consequences. 2008;5–22.
4. Central Statistical Agency. 2014 Ethiopia Mini Demographic and Health Survey (EMDHS). 2014;(August):111.
5. CSA, ICF. Central Statistical Agency (CSA) [Ethiopia] and ICF. Ethiopia Demographic and Health Survey. Key indicators report. Addis Ababa and Rockville: 2016;
6. Tariku A, Andargie Bikis G, Woldie H, Wassie MM, Worku AG. Child wasting is a severe public health problem in the predominantly rural population of Ethiopia : A community based ... Child wasting is a severe public health problem in the predominantly rural population of Ethiopia : A community based cross – section. 2017;(June).
7. Ayana AB, Hailemariam TW, Melke AS. Determinants of acute malnutrition among children aged 6 – 59 months in Public Hospitals , Oromia region , West Ethiopia : a case – control study. BMC Nutr [Internet]. 2015;1–11. Available from: <http://dx.doi.org/10.1186/s40795-015-0031-9>

8. Eshetu A. Determinant of Severe Acute Malnutrition among Children Aged 6-59 Months in Konso , Southern Ethiopia : Case Control Study. 2016;24:181–6.
9. Amsalu S. The outcome of severe malnutrition in north-West Ethiopia: a retrospective analysis of admissions. *Ethiop Med J.* 2006;44.
10. Mishra K, Kumar P, Basu S. Risk Factors for Severe Acute Malnutrition in Children below 5 y of Age in India : A Case-Control Study. 2014;81(February 2011):762–5.
11. Goyal S, Agarwal N. Risk factors for severe acute malnutrition in Central India. 2015;2(2):70–2.
12. Dereje N. Determinants of Severe Acute Malnutrition among Under Five Children in Shashogo Woreda , Southern Ethiopia : A Community Based Matched Case Control Study. 2014;4(5).
13. Coates J, Bilinsky P, Coates J. Household Food Insecurity Access Scale ( HFIAS ) for Measurement of Food Access : Indicator Guide VERSION 3 Household Food Insecurity Access Scale ( HFIAS ) for Measurement of Food Access : Indicator Guide VERSION 3. 2007;(August).
14. Daelmans B, Dewey K AM. New and updated indicators for assessing infant and young child feeding. *Food Nutr Bull.* 2009;30(2):S256–S62.e.
15. Mohamed S, Hussein MD. PREVALENCE OF ACUTE MALNUTRITION IN PRE-SCHOOL CHILDREN IN A RURAL AREA OF NORTHERN SUDAN. *East Afr Med J* [Internet]. 2014 Jan;91(1):8—12. Available from: <http://europepmc.org/abstract/MED/26862630>
16. Habtamu Oljira VKJ. RISK FACTORS FOR SEVERE ACUTE MALNUTRITION IN UNDER FIVE. 2016;(2394).

17. Motbainor A, Worku A, Kumie A. Stunting Is Associated with Food Diversity while Wasting with Food Insecurity among Underfive Children in East and West Gojjam Zones of Amhara Region , Ethiopia. 2015;1–14.
18. Abdurahman AA, Mirzaei K, Dorosty AR, Kedir H, Abdurahman AA, Mirzaei K, et al. Household Food Insecurity May Predict Underweightand Wasting among Children Aged 24 – 59 Months. *Ecol Food Nutr* [Internet]. 2016;55(5):456–72. Available from: <http://dx.doi.org/10.1080/03670244.2016.1207069>
19. Mulu E, Mengistie B. Household food insecurity and its association with nutritional status of under five children in Sekela District , Western Ethiopia : a comparative cross-sectional study. 2017;1–9.
20. Jemal Z, Hassen K WT. *Journal of Nutrition & Food Sciences* Household Food Insecurity and its Association with Nutritional Status. 2016;6(6).
21. Cook, J. T., Frank, D. A., Berkowitz, C., Black, M. M., Casey, P. H., Cutts, D. B., Meyers AF, Zaldivar, N., Skalicky, A., Levenson, S., Heeren, T. & Nord M. Food insecurity is associated with adverse health outcomes among human infants and toddlers. *J Nutr*. 2004;Vol. 134(No. (6)):1432–8.
22. Oh, S. Y. & Hong MJ. Food insecurity is associated with dietary intake and body size of Korean children from low-income families in urban areas. *Eur J Clin Nutr*. 2003;Vol. 57(No. (12)):1598–604.
23. Egata G, Berhane Y, Worku A. Predictors of acute undernutrition among children aged 6 to 36 months in east rural Ethiopia : a community based nested case - control study. 2014;
24. Kumar A, Singh VK. A Study of Exclusive Breastfeeding and its impact on

- Nutritional Status of Child in EAG States. 2015;445(3):435–45.
25. Liu E, Msamanga G, Aboud S, Fawzi WW. Relationship of exclusive breast-feeding to infections and growth of Tanzanian children born to HIV-infected women. 2012;14(7):1251–8.
  26. Mahgoub SEO, Nnyepi M, Bandeke T. Factors affecting prevalence of malnutrition among children under three years of age in Botswana. 2006;6(1).
  27. Bantamen G, Belaynew W, Dube J. Nutrition & Food Assessment of Factors Associated with Malnutrition among Under Five Years Age Children at Machakel Woreda , Northwest Ethiopia : A Case Control Study. 2014;4(1):1–7.