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PREDICTORS AND PREVALENCE OF ANEMIA, AMONG CHILDREN AGED 6 TO 59 MONTHS IN SHEBELLE ZONE, SOMALI REGION, EASTERN ETHIOPIA: A CROSS SECTIONAL STUDY

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ABSTRACT

Introduction: Anemia is one of the major public health problems in the world. Anemia affected 273.2 million under five children in 2011 of which 62.2 % occur to Sub-Saharan Africa. Ethiopia is one of the seriously affected countries in this region. Hence, the aim of the study is to assess the prevalence, and the predictors of preschool children anemia in Shebelle Zone of Somali Region.

Methods: A cross sectional study was conducted on 397 children 6 – 59 months and their mothers/caregivers in Gode and Adadle districts. A face-to-face interview for mothers/caregivers was done using a structured questionnaire, blood hemoglobin level of the children were measured using HemoCue 301. Anemia in this age group was diagnosed if hemoglobin level was less than 11g/dl. Bivariate and multivariable analysis was used to isolate independent predictors for under-five anemia.

Results: The mean hemoglobin level of preschool children was 9.66 ± 1.75 g/dl, while the anemia prevalence was 72%, out of which 20%, 46%, and 6% were mild, moderate, and severe anemia, respectively. Children ≤ 24 months were nearly twice (AOR = 1.888, 95% CI = 1.092, 3.362) more likely to develop anemia, Male children were more affected by anemia (AOR = 1.66, 95% CI = 1.001, 2.742). Unprotected drinking water were nearly five times (AOR = 4.88, 95% CI = 2.204, 10.820) more likely to develop anemia, and children having sing of diseases for the last two weeks were more than three times (AOR=3.44, 95% CI = 1.869, 6,321) more likely to be anemic.

Conclusion and recommendation: The mean hemoglobin level of this studied population was below the cut off for anemia (11g/dl), and the anemia prevalence in this study is very high, and approximately fifty percent of them are moderately anemic. Behavior change communication with early starting breastfeeding, de-worming, drinking clean, and boiled water, proper using of insecticide treated nets, environmental managements and other services are highly required.

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INTRODUCTION

Globally, anemia is one of the major public health problems that affect over 1.6 billion individuals of all age groups of both industrialized and developing nations, the overall prevalence rate was reported 24.8% (de Benoist, McLean, Egli and Cogswell, 2008), and in 2011 anemia affected 273.2 million under five children, out of which almost two third (62.3%) occurs to Sub-Saharan Africa. The mean hemoglobin concentration and overall anemia prevalence for preschool children were reported 11.1g/dl, and 42.6%, respectively (World Health Organization, 2011). Anemia in children alters the motor, cognitive, and growth development, and impairs the health, and socio-economic improvement of the community (Gutema, Adissu, Asress and Gedefaw, 2014; Haidar, 2010; Pasricha, Hayes, Kalumba and Biggs, 2013; Sanou and Ngnie-teta, 2012). In under developed countries an average of 3500 million people is anemic (Ewusie, Ahiadeke, Beyene and Hamid, 2014). At least half (50%) of the anemic people are contributed by iron deficiency, and remaining half is due to different factors such as, acute or chronic infections, Intestinal parasites, bleeding, and other nutrients deficiencies; Vitamins B12, A, C, and folic acid (Chandyo, Ulak, Adhikari, Sommerfelt and Strand, 2015; de Benoist *et al.,* 2008; Haidar, 2010; Soares Magalhães and Clements, 2011; United Nations system and standerd committee on nutrition, 2010; WHO, 2001; World Health Organization, 2011). According to World Health Organization (WHO), anemia in under-five children is defined as hemoglobin concentration less than 11g/dl, and it is said to be mild, moderate, and severe when hemoglobin level

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is 10.0 – 10.99 g/dl, 7.0 – 9.99 g/dl, and ≤ 6.99 g/dl, respectively (WHO, 2011). Regarding the public health importance, it is classified as mild, moderate, and severe public health importance when anemia prevalence in the community reaches 5% - 19.9%, 20% - 39.9%, and ≥ 40%, respectively (de Benoist *et al.,* 2008; WHO, 2011). Children's is at the risk of anemia, because of rapid growth and development, low iron content in the food, and breast milk after six months of age. Therefore, iron supplementation is necessary for the children after six months (Chandyo *et al.,* 2015). Anemia prevalence in under-five children was reported 32.8%, and 51.2% in two different studies in Brazil, and the main contributing factors was sex of the child, age of the child, wealth index, mother's age, mother's educational level, number of under-five children in the family, and source of drinking water (Leite *et al.,* 2013; Luciana *et al.,* 2011), the under-five anemia prevalence in rural and urban residence was 36.6% and 31.5%, respectively (Luciana *et al.,* 2011). Study in Lao people's democratic republic reported under-five anemia prevalence of 48.9% (Kounnavong *et al.,* 2011), in Haiti the anemia prevalence were seen 58.8%, with 22.9% mild, 33.9% moderate, and 2.2% severe (Heidkamp *et al.,* 2013). Some of the predictors were; mothers education, family size (Kounnavong *et al.,* 2011), age of the child, wealth index, residence, and sex of the child (Heidkamp *et al.,* 2013).

The overall prevalence of anemia in preschool children in sub-Saharan African countries ranges from the lowest Swaziland 42% to the highest Burkina Faso 91% (Ewusie *et al.,* 2014; Green, Sousa-figueiredo and Basáñez, 2011; Hiba H. Mahmoud, Abdelrahim M. Muddathir, Alkhawad, Mohamed, Elmubarak and Mohamed, 2014; Semedo, Santos, Baião, Luiz and Veiga, 2014; Soares Magalhães and Clements, 2011)]. While the anemia severity was reported mild, moderate, and severe, 21%, 49% and 7% in western Africa, 24%, 34% and 4%, in eastern Africa (Soares Magalhães and Clements, 2011), 22.6, 48% and 7.8% in Ghana (Ewusie *et al.,* 2014), 38%, 31.8%, and 0.8% in Nigeria (Onyemaobi and Onimawo, 2011), respectively, and 22% severe anemia in Sudan (Hiba H. Mahmoud, Abdelrahim M. Muddathir *et al.,* 2014). The main predictors reported were wealth index (Semedo *et al.,* 2014), maternal age (Mamabolo and Alberts, 2014; Semedo *et al.,* 2014), mother's education, nutritional status of the child (Mamabolo and Alberts, 2014), age, and sex of the child (Ewusie *et al.,* 2014; Kisiangani, Mbakaya and Makokha, 2015; Mamabolo and Alberts, 2014), and family income (Ewusie *et al.,* 2014), Where anemia decreases to the age of the child (Kisiangani *et al.,* 2015; Kounnavong *et al.,* 2011; Mamabolo and Alberts, 2014; Onyemaobi and Onimawo, 2011; Semedo *et al.,* 2014).

The mean hemoglobin level of preschool children in Nigeria was reported 10.48g/dl, the rural area participants were more affected than urban 78.7% vs 62% (Onyemaobi and Onimawo, 2011). The first public health concern in Sub-Saharan countries was to decrease the child mortality rates (Scott, Chen-Edinboro, Caulfield and Murray-Kolb, 2014). In Ethiopia, Despite a number of program to decrease under-five anemia such as; Long lasting insecticide treated nets (LLINs) distribution, De-worming, community based nutrition (CBN), enhanced outreach strategy (EOS), micronutrient interventions, essential nutrition action (ENA), and health facility nutrition services in the country, the preschool children anemia remains one of the main public health problems, with prevalence rate of 44%, (68.7% in Somali region) of which 21% mild, 20% moderate, and 3% severe anemia. Forty five percent occur to rural and 35% in urban (CSA, 2012). Other studies in Ethiopia, showed that 37.3% - 50.3% of under-five anemia prevalence (AA, SA, TW and T., 1999; Gebreegziabiher, Etana and Niggusie, 2014; Habte *et al.,* 2013), with 3.6% severe anemia (Habte *et al.,* 2013), and 25.5%, 11.4% and 0.4% mild, moderate and severely anemic respectively (Gebreegziabiher *et al.,* 2014). The main predictors of anemia in preschool children were age of the child, wealth index, child nutritional status (Gebreegziabiher *et al.,* 2014; Habte *et al.,* 2013), maternal education, maternal health status (AA *et al.,* 1999; Habte *et al.,* 2013), Vitamin A supplementation, De-worming, residence, mother's age (Habte *et al.,* 2013), un-safe water supply, and poor environmental sanitation (AA *et al.,* 1999).

MATERIALS AND METHODS

Study area

The study was conducted in Gode and Adadle districts of Shebelle (Gode) zone, Somali Region eastern Ethiopia. The Zone is located in the southern part of the region and about 600km from the main town of the region (Jijiga) and 1200km from Addis Ababa the capital city of Ethiopia. This zone is bordered by Korehey, Nogob, and Afder zones of Somali Region on the Northeast, north and west, respectively, by Somalia government on the South. The zone is subdivided in to 9 administrative districts; (Gode, Kalafo, Mustahil, Ferfer, Adadle, Danan, Ber-ano, East-emey and El-wayne), 70 kebeles and about 230 villages, with a total population of more than half million people, with 55.7% male and 44.3% female (CSA, 2008; Somali Regional Health Bureau (SRHB), 2010). The weather is always as hot as ≥ 37 degree centigrade, there are two rainy seasons locally known as: Gu, (the long rain season) and Deyr (the short rain season). The zone is characterized by semi-arid with an average rain fall of 500mm per year. As of the most part of the Region the zone has high temperature vary from 18^{o}c to 45^{o}c, and relative low humidity (SRHB, 2010).

Study Design and period

A community based cross sectional study (baseline for intervention study) was conducted in August, 2014 among 415 under-five children (0-59.9 months) and their mothers/caregivers enrolled in nutritional status and its determinants study, and excluded those children less than six months of age. This makes the sample size 397 children 6 – 59.9 months, and their mothers/caregivers.

Sample Population and sample size

The sample population was a pair of all children between 6-59 months and their mothers/caregivers, living in randomly selected households in Shabelle Zone, Somali Region. To calculate the sample size for this study, a single population proportion formula was used, using anemia prevalence of under five children in Somali region, which was 67.8% (CSA, 2012), to get a large and representative sample size, with 95% confidence interval and 5% marginal of error. On the basis of the above assumptions, the required sample size for this study will be calculated by using the following formula (AG, 2009), considering 20% for non-response rate. Thus, the total sample sizes will be 334 participants. The formula was as below.

$$Z^2\alpha/2\ x\frac{(pq)}{d^2} = (1.96^2)\text{x}\frac{0.678*(1-0.678)}{0.05^2} = 334$$

Where:

n= Sample size
Z= Standard normal curve with 95% confidence intervals (1.96).
P= proportion of stunted children in Ethiopia (0.68).
q= 1-p (0.32)
d= margin of error/degree of precision (5%)

Data collection and measurement

A pre-tested structured questionnaire was used. The questionnaire was prepared in English and then translated into Somali language and then back to English to ensure its consistency. The information included in the questionnaire was socio-demographic and economic characteristics, some routine health services, morbidity, and source of drinking water. The hemoglobin (Hb) level of the children was determined, because it is the easiest and best way to indicate nutritional anemia, caused by Iron, Foliate, Vitamin B12 and other nutrients deficiencies. To measure the Hb level the cut off in under-five children is about 11g/dl (WHO, 2011). A portable hemoglobin photometer (HemoCue -Hb301analyzer; Sweden) was used (Gibson R, 2005; Lee R. and Nieman D, 2010). This material is easy to use, quick result and comparable with other methods of hemoglobin meters (Gibson R, 2005; Nkrumah *et al.,* 2011). The blood sample was obtained from the capillary blood by sticking finger with a sterile lancet, after cleaning the finger with swap using antiseptic solution, and dried. The first drop of blood was discarded; the second enough drop of blood was put on to the microcuvette and the filled microcuvette were placed in to the HemoCue for hemoglobin level measurement. In general, World Health Organization defined Anemia in under-five children as the presence of Hb level less than 11g/dl, which is again categorized in to mild (10 – 10.99g/dl), moderate (7 – 9.99g/dl), and severe (<7g/dl) (WHO, 2011). The data were collected by degree and diploma health professionals after two days training, and one day Pre-test which was conducted in a village that was not included in the actual study area. Amendment was made in the questionnaire depending on the finding of the pre- test. Continue checking for accuracy and completeness was done by the principal investigator, and the supervisors, every night during data collection, any missing information was retraced.

Data Analyses

The data were checked for completeness, and any incomplete information was excluded from the entry. The data were coded; entered cleaned and analyzed using SPSS (SPSS Inc. version 20, Chicago, Illinois). A descriptive statistical analysis was done, and mean standard deviation (SD) were used to describe the socio-demographic characteristics and prevalence of Anemia. In addition, cross tab using chi-square and bivariate logistic regression were used to identify the candidate variables for multivariable analysis. A Multivariable logistic regression analyses were used to isolate the independent predictors of anemia among children under- five years of age. Ethical clearance was obtained from the International Islamic University Malaysia (IIUM) Research Ethical Committee (IREC). A written official letter was also obtained from Somali Regional Health Bureau and Shebelle zone administrator. The participants were properly informed about the purpose, and importance of the study, and informed verbal consent was obtained from the mothers/caregivers, prior to the data collection. Because, the majority of the mothers/caregivers in the study area were illiterate (can't read and write). The interviewers/data collectors were given a written statement to read and sign after the acceptance of the participants. This was clearly reported in the proposal and agrees all the concerned body. Since, our data collection method has no an evidence to harm the participants, it was only interview, and blood sample with finger prick. The participants were encouraged to be honest as much as possible, since the information given by them is useful and very important to them, the district, the Region and to the country. Confidentiality was assured by keeping all information in a proper place. In addition, if somebody sick with malnourished is seen, the team was sending to the nearest health facility for help.

RESULTS

A total of 397 children between the ages of 6 – 59 months were enrolled in the study. The mean (±SD) age of the children was 24.94 (± 13.43) months. The male to female ratio of the children was 1.15. The majority (70%) of the participants were from rural resident. All mothers did not remember the exact date of birth, while only 0.5% do reported the weight of their child at birth. The majority (87.4%) of the mothers/caregivers were illiterate, and (85%) were housewives by occupation with mean (±SD) mothers/caregivers age of 28.8 (± 7.88) years. All respondents (100%) were Muslim by religion, and Somali by Ethnic group. The mean (±SD) family size, and number of under –five children in the family were 5.76 (± 2.1), and 1.96 (± 0.69) persons respectively, the lower wealth index people showed higher significant $p<0.05$ (Table 1). The initiation of breastfeeding within one hour and after one hour of delivery was almost equal (50%). Whereas, more than two third (64.2%) of the mothers/caregivers started complementary feeding while the age of the child is less than six months of life. The cross tabulation of under-five anemia prevalence with some characteristics was found statistically significant ($p<0.05$) to district, residence, age of the child, time initiation of breastfeeding, time initiation of complementary feeding (Table 2). More than ninety percent of the children were vaccinated at least ones for life time, and 81.6% of the respondents were reported using insecticide treated nets (ITNs), of which the majority (93.5%) of the children was persistently sleeping under ITNs every night for the past three months. To the contrary, seventy four percent, and 66% of the children were not de-wormed, and not supplemented with vitamin A, respectively. Unprotected water (88.4%) was the main source of drinking water for the study population. Regarding the common childhood diseases, 78% of the children had at least one time attack during the last two weeks, prior to the study day. Using chi-square test, all these variables were significantly associated with child anemia; none ITNs users, not vaccinated, not de-wormed, not supplemented with Vitamin A, and not drinking protected water were more anemic with $p <0.05$, compared to their counterpart. ITNs sleeping pattern were not significantly related with anemia $p >0.05$ (Table 2). The overall anemia prevalence and it is level among children 6 – 59 months of age was 72%, including 20%, 46%, and 6% mild, moderate, and severe anemia, respectively. The mean hemoglobin level was 9.66 ± 1.75 (Figure 1).

Table 1. Socio-demographic, and economic characteristics among children 6-59 months by anemia in Shebelle Zone, Somali Region, Eastern Ethiopia

Variables (n=397)	Categories	Frequency	Anemia		p
			Yes %	No %	
District	Adadle	203	79.3	20.7	0.001
	Gode	194	64.9	35.1	
Residence	Urban	63	54.0	46.0	0.001
	Semi-urban	56	83.9	16.1	
	Rural	278	74.1	25.9	
Age of the children (months)	≤24	268	78.0	22.0	<0.001
	>24	129	60.5	39.5	
Sex of the child	Male	212	75.5	24.5	0.130
	Female	185	68.6	31.4	
Family size	1 - 3	51	70.6	29.4	0.831
	4 - 6	218	71.6	28.4	
	≥ 7	128	74.2	25.8	
Number of under five children	1	95	69.5	30.5	0.754
	2	227	73.6	26.4	
	≥3	75	72.0	28.0	
Mothers/caregivers age	≤ 18	16	87.5	12.5	0.078
	19 – 25	134	64.9	35.1	
	26 -35	188	76.1	23.9	
	≥36	59	72.9	27.1	
Mothers/caregivers educational level	Literate	50	74.0	26.0	0.773
	Illiterate	347	72.0	28.0	
Mothers/caregivers occupation	House wife	336	73.5	26.5	0.203
	Others	61	65.6	34.4	
Family wealth index (tertile)	High	128	75.8	24.2	0.008
	Middle	134	62.7	37.3	
	Low	135	78.5	21.5	

P = p-value

Table 2. Some routine health services, morbidity, ITNs use, child feeding and source of drinking water characteristics among children 6-59 months by anemia in Shebelle Zone, Somali Region, Eastern Ethiopia

Variables (n=397)	Categories	Frequency	Anemia		p
			Yes %	No %	
Time initiation of BF	Within one hour	188	66.5	33.5	0.014
	After one hour	109	77.5	2`2.5	
Initiation of CF	at 6 months	75	62.7	37.3	0.022
	< 6 months	255	76.9	23.1	
	> 6 months	67	65.7	34.3	
Insecticide treated nets use (ITNs)	Yes	324	70.1	30.6	0.036
	No	73	82.2	17.8	
ITNs sleeping pattern per night for last three months	Persistently	303	70.0	30.0	0.888
	Some times	21	71.4	28.6	
Disease during last two weeks♠	Yes	312	77.9	22.1	<0.001
	No	85	51.8	48.2	
Immunization at least once	Yes	358	70.7	29.3	0.029
	No	39	87.2	12.8	
De-worming last 6 months	Yes	104	59.6	40.4	0.001
	No	293	76.8	23.2	
Vitamin A Suppl. last 6 months	Yes	104	65.0	35.0	0.018
	No	260	76.2	23.8	
Source of drinking water	Protected	46	37.0	63.0	<0.001
	Unprotected	351	76.9	24.1	

P = p-value, BF = breastfeeding, CF = complementary feeding, ITNs = Insecticide Treated Nets
♠The main common diseases reported were 56.1% fever, 28.8% cough, 13.8%% diarrhea, and 1.3% others

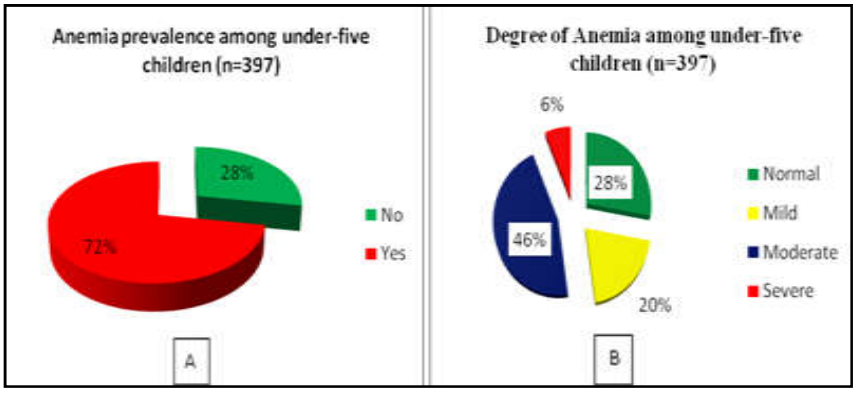

Figure 1. (A&B), Anemia prevalence and degree, among under-five children in Shebelle Zone, Somali Region, Eastern Ethiopia

The study area has an altitude level of below 1000 meters above sea level. Therefore, an altitude adjustment was not needed (SRHB, 2010; WHO, 2011). Regarding the hemoglobin level (g/dl) by sex of the children, severe anemia were doubled, and moderate anemia were slightly higher in male children, compared to their counterpart, while female children were slightly higher in the hemoglobin level of 10 – 10.99 g/dl (Figure 2).

Bivariate logistic regression analyses predicting anemia status of children 6 -59 months by Socio-demographic, economic and some routine health services activities, morbidity, and source of drinking water characteristics are shown in Table 3. Children living in Adadle district were 2.1 times (COR = 2.069, 95% CI = 1.319, 3.244) more likely to have anemia compared to those living in Gode district.

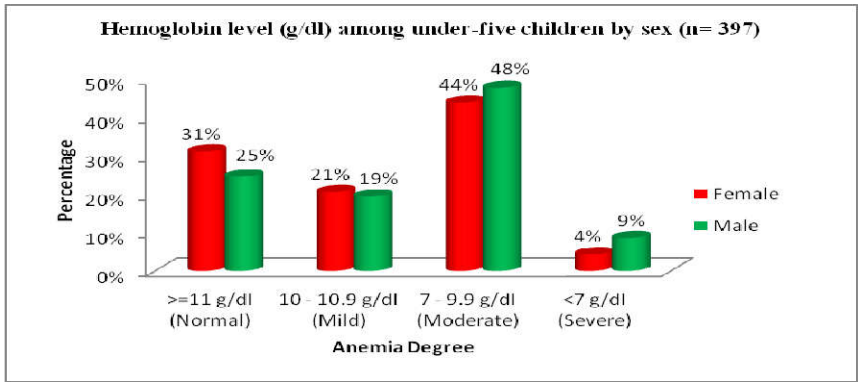

Figure 2. Hemoglobin level (g/dl) among under-five children by sex in Shebelle Zone, Somali Region, Eastern Ethiopia

Table 3. Bivariate logistic regression model predicting the likelihood of 6 – 59 months children having anemia by Socio-demographic, economic and some routine health services, morbidity, and source of drinking water characteristics in Shebelle Zone, Somali Region, Eastern Ethiopia

Variables (n=397)	Categories	COR for 95% CI
District	Adadle	2.069 (1.319, 3.244) **
	Gode	1
Riddance	Urban	1
	Semi urban	4.454([1.869,10.614)**
	Rural	2.440 (1.389, 4.287)**
Child age	≤24	2.316 (1.468, 3.655)***
	>24	1
Child sex	Female	1
	Male	1.405 (0.904, 2.184)
Family Size	1 - 3	1
	4 - 6	1.048 (0.536, 2.050)
	≥ 7	1.199 (0.583, 2.466)
Number of under-five children in the family	1	1
	2	1.223 (0.722, 2.071)
	≥ 3	1.130 (0.580, 2.201)
Age of mother/caregivers	≤18	1
	19 - 25	0.264 (0.058, 1.213)
	28 - 35	0.454 (0.099, 2.074)
	≥36	0.384 (0.078, 1.881)
Mothers/caregivers educational level	Literate	1
	Illiterate	0.906 (0.462, 1.777)
Mothers/caregivers occupation	Housewife	1.457 (0.815, 2.605)
	Others	1
Time initiation of BF	Within one hour	1
	After one hour	1.737 (1.114, 2.708)**
Time initiation of CF	At six months	1
	Less than six months	1.979 (1.141, 3.434)**
	Above six months	1.140 (0.573, 2.268)
Wealth Index	poor	0.856 (0.481, 1.523)
	Middle	0.460 (0.268, 0.788)**
	Rich	1
Water source	Protected	1
	Un-protected	5.686 (2.974, 10.872)***
Use of Insecticide treated nets	Yes	1
	No	1.972 (1.035, 3.759)*
Immunization	Yes	1
	No	2.822 (1.074, 7.414)*
Disease for the last 2 weeks	Yes	3.282 (1.985, 5.424)***
	No	1
Seek treatment	Yes	1.390 (0.696, 2.774)
	No	1
De-worming last 6 months	Yes	1
	No	2.241 (1.392, 3.609)**
Vitamin A supp. Last 6 months	Yes	1
	No	1.722 (1.096, 2.707)**

* = P-value <0.05, ** = P-value <0.01, *** = P-value <0.001, BF = breastfeeding, CF=Complementary feeding

The semi-urban and rural residences were 4.5 times, and 2.4 times (COR = 4.454, 95% CI = 1.869, 10.614 and COR = 2.440, 95% CI = 1.389, 4.287) more likely to be anemic, compared to urban residing children, respectively. Children's less than 24 months were nearly two time (COR = 2.316, 95% CI = 1.468, 3.655) more likely to develop anemia compared to above 24 months. Drinking unprotected water were 5.7 times more likely to have anemia (COR = 5.686, 95% CI = 2.974, 10.872), having a disease history for the last two weeks, and mot immunized were almost three times (COR =3.3, 95% CI = 1.985, 5.424), and two times (COR = 2.8, 95% CI = 1.074, 7.414) more likely to have anemia compared to their counterpart, worming, ITNs use, immunization, and Vitamin A supplementation were not significantly associated (Table 4). Multivariable logistic regression were included variables with p <0.2 in bivariate analysis, while residence and time initiation of CF variables were removed from final model.

DISCUSSION

In this study prevalence of anemia among preschool children is very high (72%), which indicate, anemia as a major severe public health problem in this community. This finding is higher, compared to EHDS 2011finding in both national (44%), and Somali region (68.7%) anemia prevalence of under

Table 4. Multivariable logistic regression model predicting the likelihood of 6-59 months children having anemia by Socio-demographic, economic, and some routine health services, morbidity, and source of drinking water characteristics in Shebelle Zone, Somali Region, Eastern Ethiopia

Variable (n=397)	Categories	AOR for 95% C.I.
District	Gode	1
	Adadle	0.971(0.536, 1.761)
Child age	≤24	1.888 (1.092, 3.362) *
	>24	1
Child sex	Male	1.657 (1.001, 2.742) *
	Female	1
Caregiver's age	≤18	1
	19 - 25	0.308 (0.057, 1.663)
	28 - 35	0.546 (0.101, 2.951)
	≥36	0.787 (0.131, 4.713)
Caregiver's occupation	House wife	1.493 (0.738, 3.020)
	Others	1
Time initiation of breastfeeding	Within one hour	1
	After one hour	0.856 (0.480, 1.526)
Wealth Index	poor	1.424 (0.720, 2.816)
	Middle	0.841 (0.444, 1.593)
	Rich	1
Water source	Protected	1
	Un-protected	4.883 (2.204, 10.820)***
Use of Insecticide treated nets	Yes	1
	No	1.506 (0.716, 3.169)
Immunization	Yes	1
	No	1.580 (0.537, 4.646)
Disease for the last 2 weeks	Yes	3.437 (1.869, 6.321) ***
	No	1
De-worming last 6 months	Yes	1
	No	1.815 (0.965, 3.414)
Vitamin A supp. Last 6 months	Yes	1
	No	1.252 (0.682, 2.299)
Hosmer and Lemeshow Test for model fitness (P)		0.534
Cox & Snell's Pseudo R^2		0.183
Nagelkerke R^2		0.264

* = P-value <0.05, ** = P-value <0.01, *** = P-value <0.001
AOR = Adjusted Odds Ratio, CI = Confidence Interval, P = p-value
Multivariable logistic regression were included variables with p <0.2 in bivariate analysis, while residence and time initiation of CF variables were removed from final model.

On the other hand, those children from family with middle wealth index were 54% (COR = 0.46, 95% CI = 0.268, 0.788) less likely to have anemia compared to children from rich families (Table 3). A multivariable logistic regression analysis model predicting anemia status of children 6-59 months by socio-demographic, economic, and some basic services characteristics after adjusting all other variables were done; children ≤ 24 months and male children were nearly twice (AOR =1.888, 95% CI= 1.092, 3.362), and (AOR= 1.657, 95% CI =1.001, 2.742) more likely to be anemic compared to their counterpart, respectively. Furthermore, Drinking of unprotected water were almost five times (AOR = 4.9, 95% CI= 2.204, 10.820) more likely to develop anemia compared to drinking protected water, and morbidity for the last two weeks were triple times (AOR= 3.4, 95% CI= 1.869, 6.321) more likely to be anemic compared to non diseased child. Age of the caregivers, Time initiation of breastfeeding, wealth index, De-

five children (CSA, 2012), and also other studies in Ethiopia, ranging from 37.3% to 50.3% of under-five anemia prevalence's (AA *et al.,* 1999; Gebreegziabiher *et al.,* 2014; Habte *et al.,* 2013). Similarly, our study result was higher than the result seen in some countries in the world including Sub Saharan Africa (Heidkamp *et al.,* 2013; Kisiangani *et al.,* 2015; Kounnavong *et al.,* 2011; Luciana *et al.,* 2011; Onyemaobi and Onimawo, 2011; Semedo *et al.,* 2014; Soares Magalhães and Clements, 2011). Nevertheless, our result was lower than the results obtained from studies in some developing countries ranging from 76.5% in Morocco to 91% in Burkina Faso (El Hioui, Farsi, Aboussaleh, Touhami Ahami and Achicha, 2010; Ewusie *et al.,* 2014; Hiba H. Mahmoud, Abdelrahim M. Muddathir *et al.,* 2014; Simbauranga, Kamugisha, Hokororo, Kidenya and Makani, 2015; Soares Magalhães and Clements, 2011). This difference might be due to the geographical, and way of life variation in different areas

or/and countries. Regarding the under-five anemia severity, out of the total children 20% were mildly anemic in our study; this was relatively similar with EDHS 2011 finding (CSA, 2012), and results from study in some Western African countries (Ewusie *et al.,* 2014; Soares Magalhães and Clements, 2011). However, our result was lower than the findings from study in Ethiopia (Gebreegziabiher *et al.,* 2014), and East African countries (Soares Magalhães and Clements, 2011). But, this result was much higher than the finding from study in Kenya (Kisiangani *et al.,* 2015). Moreover, our study revealed 46% of moderately anemic children, this is much higher than EDHS 2011 finding and result from study in the other part of the country (CSA, 2012; Gebreegziabiher *et al.,* 2014), and result in some eastern African countries (Soares Magalhães and Clements, 2011) including Kenya (Kisiangani *et al.,* 2015). On the country, our result was lower than the finding obtained from some Western African Countries (Soares Magalhães and Clements, 2011) including Ghana (Ewusie *et al.,* 2014). Finally, 6% of the preschool children were severely anemic in this study, this was much higher than EDHS 2011 data (CSA, 2012), and result obtained from other study in the country (Gebreegziabiher *et al.,* 2014), this was also higher compared to the result obtained from some eastern African countries. But, our finding was approximately similar to some western African countries (Soares Magalhães and Clements, 2011). These differences could be the difference in living standard, socioeconomic, and geographical disparity.

Several studies on a preschool children's reported differences in sex-related anemia prevalence, boys were more anemic than girls (Heidkamp *et al.,* 2013; Kisiangani *et al.,* 2015; Leite *et al.,* 2013; Mamabolo and Alberts, 2014), this was similar with our finding were male children was more anemic than female.
In this study, the anemia prevalence decreased, as the age of the children increase. This finding is similar to other studies carried out in the other part of Ethiopia (Gebreegziabiher *et al.,* 2014; Habte *et al.,* 2013), and in developing countries (Agho, Dibley, D'Este and Gibberd, 2008; Heidkamp *et al.,* 2013; Kisiangani *et al.,* 2015; Leite *et al.,* 2013; Onyemaobi and Onimawo, 2011; Semedo *et al.,* 2014). The predictors of anemia in preschool children was sex of the child, age of the child, source of drinking water, disease for the last two weeks prior to the study day. This is similar with other studies in the world (AA *et al.,* 1999; Agho *et al.,* 2008; Ewusie *et al.,* 2014; Gebreegziabiher *et al.,* 2014; Habte *et al.,* 2013; Heidkamp *et al.,* 2013; Kisiangani *et al.,* 2015; Leite *et al.,* 2013; Luciana *et al.,* 2011; Mamabolo and Alberts, 2014; Onyemaobi and Onimawo, 2011; Semedo *et al.,* 2014). The strengths in this study were using of more experience (participated other studies), and qualified health professional as data collectors and supervisors after two days training and pilot test, and using structured standard validated questionnaire. Whereas, the cross-sectional study design that might limit to set the causal relationship between the outcome and explanatory variables, possibility of social desirability bias on wealth, and recall bias on breastfeeding initiation can be some of the limitations.

Conclusion

The mean hemoglobin level of this study population was below the cut off for anemia (11g/dl), and the anemia prevalence was very high of which approximately fifty percent of the children were moderately anemic. The age of the child was important factor as age increase the anemia prevalence decreases. In addition, the anemia prevalence was higher in Adadle district residing participants, and children's lately started breastfeeding were more anemic than those who started earlier (within one hour). Furthermore, children's who is drinking unprotected water, having any diseases during past two weeks prior to the study day, and not de-warmed during last six months was more anemic than their counterparts. Therefore, behavior change communication focusing on early starting breastfeeding, immunization, de-worming, drinking clean and boiled water, and proper using of TINs, environmental managements and other services should be in place.

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Competing of Interest: The authors declare that, there is no competing of interest

Authors Contribution: RA brought the inception of the study, designed the proposal, managed data collection, analysis and report writing. NM, TB, WM and NA worked closely with RA in the refinement of the proposal, field work, analysis, and report writing. All authors read and approved the submission of this paper.

Availability of data: The authors declare that, the data is available.

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