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Original Research Article

Anemia and Associated Factors among Drought Affected Children Aged 6-59 Months

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ABSTRACT

Background:- Ethiopia had been facing a massive drought worsened by the 2015 El Niño. However, there was paucity of data on prevalence of anemia where food insecurity was heightened due to climate shock.
Objective:-The objective of this study was to assess the prevalence of anemia and associated factors among drought affected children aged 6-59 months in Doddota District.
Methods: - A community based cross sectional study design was conducted using simple random sampling technique to select the study participants. A structured questionnaire administered to a mother/caregiver, blood sample and Anthropometric data were collected for each child. Bivariate and Multi-variable logistic regression analysis with odds ratio of 95 % confidence interval was used to assess the association between independent and dependent variables.
Results:- A total of 422 mothers/children were participated in the study. The overall prevalence of anemia was 48.3% [CI: 43.61, 53.10].The lowest mean haemoglobin level (10.2gm/dl) was observed among children age 6 to 11 months. Except for age group 36 to 47 months, there was a significant mean haemoglobin difference between lower age groups and children age 48 to 59 months(**P-value <0.001**). In multiple logistic regression analysis, children aged 6 to 11months[AOR= 9.2,(95%CI:3.57, 24.11)], children in rural areas [AOR =2.0,(CI:1.26, 3.27)],children of mothers with no education [AOR =2.7, (95% CI: 1.20, 6.15)],stunted children [AOR= 1.7, (95% CI: 1.01, 3.14)], and children with history of vaccination [AOR=0.10,(95% CI:0.12,0.79)] were found to have a significant association with anemia.
Conclusion: -The prevalence of anemia was high compared to WHO cut off points (≥40%).Child age, place of residence, maternal educational level, stunting, and vaccination history were the predicting factors of childhood anemia.

Key words: Anemia, children, Drought, Doddota, Ethiopia

1. INTRODUCTION

Anemia is defined as low hemoglobin concentration less than 11gm/dl for children below five years of age. It is one of the public health problems which have severe impacts on health, social and economic development. [1] The causes are multiple, ranging from micronutrient deficiencies like folate, riboflavin, vitamins A and B12 to acute and chronic infections. In addition, inherited or acquired disorders that affect hemoglobin formation, red blood cell production or red blood cell survival can result in anemia. [2,3] It has cognitive and intellectual ability, motor development, coordination, language development, and poor school performance. [4-6] The intellectual performance/intelligence

quotients [I.Q] of anemic children are lower than non anemic children. [4] According to World Health Organization (WHO), globally 42.6% of children are anemic with varying magnitude across different regions. The magnitude of anemia was 22.9% in European countries and 22% children in American regions. The prevalence in South Asian countries was estimated to be 53.8%. Higher prevalence (62.3%) of anemia among children was observed in Africa. [1] Ethiopian Federal Ministry of Health (FMOH) adopted anemia and other micronutrient deficiency control program since 2004 through implementing iron supplementation, promotion of dietary diversifications, food fortification, using insecticide treated nets for control of malaria and deworming tablets. [7] In spite of these efforts, demographic health survey result in 2011 revealed that 44% of children at national level were remained anemic. [8]

There was massive drought and food insecurity crisis triggered by a combination of failed rains and droughts that was worsened by the 2015 El Niño, which had severe health impacts on vulnerable groups of the population including children. [9] Doddota district is one of the known food insecure districts in Arsi Zone for several years. In addition, it was severely stricken by the drought for which all the households living in that area were receiving food aids. [10] According to morbidity reports from district health centers, adult anemia was the eighth top health problem in that district. [11] There is direct relationship between prevalence of adult anemia and that of children. In most cases anemia has a relationship with education, wealth and occupation with the poorest and least educated being at greatest risk of exposure to risk factors for anaemia and its sequelae. [2,12] Some studies have been conducted to investigate the association between children with malnutrition and drought affected areas. [13,14] However, as far as the knowledge of the investigators, there was no study conducted on prevalence of anemia among under five children during drought where food insecurity could be heightened due to climate shock. Therefore, examining the magnitude of anemia and associated factors during the occurrence of drought in children would provide knowledge to guide intervention strategies, generates a useful baseline for future surveys in crisis affected areas among children aged 6–59 months.

2. METHODS

2.1. Study area and period.

The study was conducted in Doddota district (**Fig 1**) from March 1 to May 30, 2016. Doddota is one of the 25 districts of the Arsi Zone, Oromia Regional state of Ethiopia. It is located 125 kilo meters southeast of Addis Ababa. [15] The total land area is 445.6 Km^2 with the altitude of 1500 meters above sea level. The temperature ranges between 17^{O}c and 33^{O}c, has a mean annual rainfall of 900 mm with only 49 days of rainy days with in the year. It is one of the food insecure districts in Arsi Zone. The total population of the district during study period was estimated at 84,729; out of which 11,523 were under five children. Two health centers and 12 health posts provide health services. [16]

Doddota district map

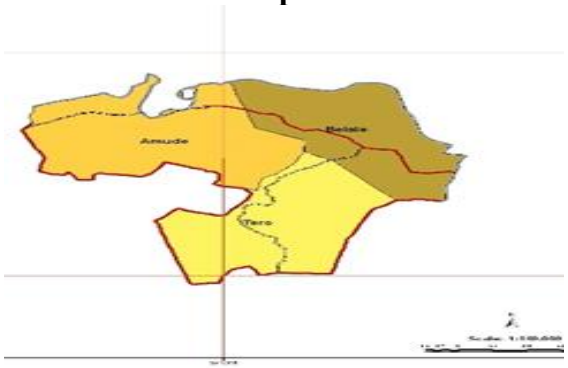

Figure 1: Doddota Distrcit in Arsi Zone (Source, Arsi Zone Health Department office, 2016).

2.2. Study design and sample size determination.

A community based cross-sectional study design was conducted. The sample size was determined using a single population proportion formula with the following assumptions. Population proportion (P) of 51.7% taken from Ethiopian Demographic Health Survey

(EDHS) report as prevalence of anemia among children aged 6–59 months in Oromia Region[10], 95% confidence level, a 5% margin of error. Then, the final sample size 366 was obtained. At last, 10% of the calculated sample size was added to compensate to potential non responses during data collection to get a total of 422 children and their mothers.

2.3. Sampling technique

Simple random sampling technique was used to select the study participants. Up dated 2016 district health posts` "family profile record folder" was used as sampling frame. Households who had under five children were identified and given consecutive numbering. Then, the target children with their mothers were randomly selected by using computer generated random selection method. Six under children were found in the same houses; one child was selected by lottery method from each houses.

2.4. Source population

All children aged 6 to 59 months lived in Doddota district during the study period

2.5. Study population

Sampled children aged 6 to 59 months living in Doddota district

2.6. Exclusion criteria

Four children were excluded from the study as they were found receiving treatment for anemia from the health facility.

2.7. Data collection

2.7.1. Data collection tools

The data on socio demographic, child characteristics and nutritional status were collected using an interviewer administered pre-tested, structured questionnaire adapted from EDHS 2011, mid-upper arm circumference (MUAC) tape ,weight scales ,height/length board used for anthropometric measurements while hemoglobin level was determined by biochemical kit using hemocue machine.

2.7.2. Data collection procedure.

Socio-demographic and anthropometric data were collected by two trained BSc nurses recruited from Doddota district Health Centers while blood sample for hemoglobin measurement was collected by two lab technologists from Adama Hospital Medical College and supervision was made by two health officers from Doddota health office. Automated Hemocue portable hemoglobin meter (Hemocue 301 Angelhem Sweden) was used to measure hemoglobin levels. One drop of capillary blood collected from the middle finger of the child by prick. Finally, anemia was diagnosed based on the WHO standards with hemoglobin levels lower than 11 g/dl. [17] Weight was measured to a precision of 0.1 kg in light cloths by SALTER model 2356S electronic scale and the length/height to a precision of 0.1 cm without shoes height/length board. The Length of children of up to two years of age was measured in lying position using length board. In addition, the children nutritional status was assessed and classified into underweight, stunting, and wasted when they were below -2 Z-score for weight for age, height for age and weight for height respectively. In addition, mid upper arm circumference was taken by measuring tape. All data collection took place at household level.

2.7.3. Data quality assurance

The questionnaires were prepared in English and then translated into local language (Afan Oromo) and later back to English by two different teachers qualified both in Afan Oromo and in English to check for consistency. Two-days training was given for data collectors, laboratory technologists and supervisors regarding study objective, interview techniques, anthropometric measurements, and ethical issues during data collection. Laboratory technologists trained in hemocue usage technique at Dera Health Center by an expert. Pre-test without hemoglobin level determination, was done among 5% of the total sample size in the Lode Lemefo area of Sire District. From the four trained data collectors, those performed with highest record of precision during training were selected. Furthermore, weighing scale was checked every morning and brought to zero

and known weight was used to adjust the scale before weighing children. Hemocue instrument allowed coming to the ambient temperature before use, protected from direct sunlight, stored at room temperature 15 to 30 degrees centigrade. Children were put in sitting position, calmed and left ring finger was warmed, relaxed and then pricking was made by hemocue lancet and cuvette container was kept closed between uses. Questionnaires were checked daily for accuracy, consistency, and completeness by supervisor. Furthermore, the supervisor and the principal investigator gave feedback and correction regarding the collected data on a daily basis to the data collectors.

2.7.4. Data processing and analysis

Data processing:- Data were checked for completeness, consistency, coded, entered, cleaned, and categorized before analysis.

Data Analysis:- WHO Anthro software v.3.0.1., was used to convert nutritional data into Z-scores of the indices by using the new WHO growth standard. The pre-coded data were entered into statistical package for social sciences (SPSS) software Version 21 for data processing and analysis. Univariate analysis was performed to describe the characteristics of the study population. Bivariate analysis with odds ratio with 95 % confidence interval was used to assess the association between independent and dependent variables. Independent variables which had association with the outcome variable in the bivariate logistic regression and those with *P* _value of ≤0.25 were considered as a candidate for the final logistic regression model. The Hosmer-Lemeshow test was used to check goodness of model fitting (p-value=0.834). Finally, collinearity and interaction between independent variables were checked and a backward variable selection method was used to run the final multivariate analysis. The 95% confidence interval was determined and factors with p-value of less than 0.05 were considered statistically significant.

2.8. Ethical considerations

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by University of Arsi Institutional Review Board (IRB) and Oromia Regional Health Bureau Research Ethics Review Committees. Before fieldwork, a meeting was arranged with local communities of the District in order to explain the purpose of the study. Consent statement explaining purpose of the test, voluntary participation, risks, benefit, autonomy and confidentiality was read for mothers. In addition, they were informed that, the results would be made available as soon as the test completed. Written consent was obtained before the procedure took place. Children with severe anemia and severe acute malnutrition were referred to the health center

3. RESULTS

3.1. Socio-demographic characteristics of the mothers.

A total of 422 mothers and their children (100% response rate) participated in this study. The mean age of mothers was 26 years (SD±6) and two third (67%) of them were under 29 years of age. The Majority of the mothers (96.4%) were married and 360 (87.4%) of them were housewives. In addition, 300 (71.1%) of them were living in rural areas, 398 (94.3 %) belonged to the Oromo ethnic group, and 269 (63.7%) of them were Muslims by religion. Concerning the educational status, 216 (51.2%) of mothers completed elementary school. On average their monthly income was estimated to be 912 Ethiopian Birr (45US dollars)(**Table1).**

3.2. Children characteristics and morbidity

From the total children, 224 (53.1%) of them were females. The mean age of the children was 25 months (SD±14.8).Majority of the mothers (70%) reported that, 102(24.1%) of their children had diarrhea, 103(24.4%) of them had cough and 59(13.9%) developed fever including 15 children diagnosed as malaria case at health

posts. In addition, 37(8.7%) of the children contracted different types of skin infections within two weeks before the study period.

Table 1: Socio-demographic characteristics of the study participants among drought affected children aged 6-59 months living in Doddota District, Arsi Zone, Oromia Regional state, Ethiopia, 2016(n=422).

Variables	Number (%)
Marital status	
Married	407(96.4)
Divorced	8(1.9)
Widowed	4(0.9)
Single	3(0.7)
Occupational status	
House wife	369(87.4)
Self-employee	18(4.3)
Farmer	16(3.8)
Daily labourer	13(3.1)
Government employee	5(1.2)
Other(student, live with family)	1(0.2)
Place of residence	
Rural	300(71.1)
Urban	122(28.9)
Ethnicity	
Oromo	398(94.3)
Amhara	20(4.7)
Gurage	3(0.7)
Others(Tigre,Somali,Kambata)	1(0.2)
Religion	
Muslim	269(63.7)
Orthodox	133(31.5)
Protestant	17(4)
Catholic	2(0.5)
Others(traditional)	1(0.2)
Paternal education	
No education	79(19.4)
Primary	238(58.5)
Secondary and above	90(22.1)
Maternal education	
No education	169(40)
Primary and above	253(60)
Family size	
1 to 5 family members	256(60.7)
≥ 5family members	166(39.3)

3.3. Magnitude of childhood anemia

Overall, 204(48.3%) [CI: 43.61, 53.10] of children were anemic **(fig 2).** The overall mean hemoglobin concentration was 10.7gm/dl (SD+1.8). The prevalence of anemia was higher (53.7%) among rural children with mean haemoglobin of 10.51mg/dl. Mean hemoglobin was lowest (10.2gm/dl) for children age 6 to 11 months. Furthermore, 17(4%) of children were severely anemic, 101(23.9%), 86(20.4%) were moderately and mildly anemic respectively.

Mean hemoglobin concentration

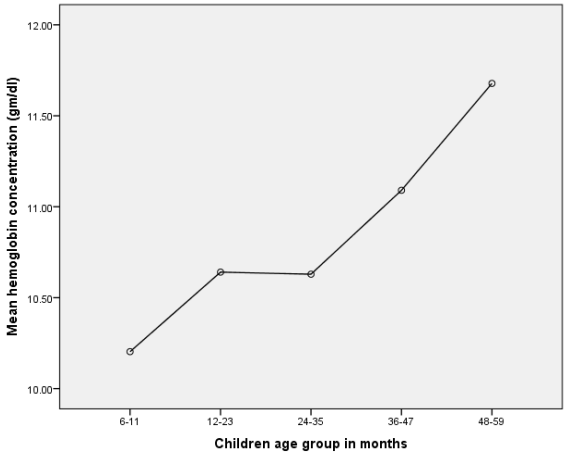

Fig 2: Mean hemoglobin concentration among drought affected children living in Doddota district, Arsi Zone, Oromia, Ethiopia

3.4. Factors Associated with Anemia.

3.4.1. Bivariate analysis

Bivariate analysis was conducted to see the crude association between each predictor and the outcome variable (prevalence of anemia). Accordingly, residences, father's education, mother education, children age group, mothers caring for another child, and vaccination history were found to have statistically significant association while stunting, and duration of illness showed p-value ≤0.25.

3.4.2. Multivariable analysis

Multicollinearity effects, outliers and interaction checked before multivariable logistic regression analysis was conducted. Finally, all variables with p-value ≤0.25 in bivariate analysis were included using forward variable selection method. After adjusting for others, child age, stunting, place of residence, mother education, and vaccination history found to be statistically significant. Accordingly, children between 6 to 11 months of age were more than nine times [AOR =9.2, (95% CI: 3.57, 24.11)] more likely to be anemic compared to children aged 48 to 59 months. Areas of residence also found to be the determinant factor for occurrence of anemia. Therefore, children living in rural areas were 2 times [AOR= 2.0 (95% CI: 1.26, 3.27)] more likely to be anemic than those living in urban. Moreover, children of mothers with

no education were 2.7 [AOR =2.7, (95% CI: 1.20, 6.19)] times more likely to be anemic than children whose mothers attended primary and above educational level. In addition, stunted children were 1.7 times [AOR= 1.7, (95% CI: 1.01, 3.14)] more likely to be anemic than children who were not stunted. On the other hand, the odd of being anemic was decreased by 90% among vaccinated children [AOR= 0.10, (95% CI: 0.01, 0.81)] as compared to those children not get vaccinated. The remaining factors did not show statistically significant association with child anemia in both bivariate and multivariate logistic regression (**Table2**).

Table 2: Determinants of anemia among children 6-59 months living in Doddota District, Arsi Zone, Oromia Regional state, Ethiopia, 2016(n=422).

Variables	Presence of anemia		COR	95% CI		AOR	95% CI		P-value
Age group	**Yes**	**No**		**Lower**	**Upper**		**Lower**	**Upper**	
6-11 months	60(63.8)	34(36.2)	8.5	3.43	21.41	9.2	3.57	24.11	***
12-23 months	73(55.7)	58(44.3)	6.1	2.527	14.79	6	2.41	15.03	***
24-35 months	41(44.1)	52(52.9)	3.8	1.54	9.52	3.8	1.51	10.03	**
36-47 months	23(36.5)	40(63.5)	2.7	1.068	7.3	2.8	1.07	7.85	*
48-59 months	7(17.1)	34(82.9)	1			1			
Residence									
Rural	43(35.2)	79(64.8)	2.1	1.377	3.28	2	1.26	3.27	**
Urban	161(53.7)	139(46.3)	1			1			
Maternal education									
No education	92(54.4%)	77(45.6%)	2.4	1.174	5.28	2.7	1.2	6.19	*
Primary and above	112(44.3%)	141(55.7%)	1.7	0.858	3.75	1.8	0.81	4.04	
Stunting									
Yes	145(53.5)	126(46.5)	1.7	0.684	1.63	1.7	1.01	3.14	*
No	59(39.1)	92(60.9)	1	1.037	2.94	0.9	0.56	1.45	
Vaccination History									
Yes	194(47.2)	217(52.8)	0.9	.011	.705	0.1	0.012	0.799	***
No	10(90.9)	1(9.1)	1			1			

Variable(s) entered child age group, place of residence, mother education level, stunting, and vaccination history [a]
*****P value <0.0001,** p value <0.005, * p value <0.05**

4. DISCUSSION

This study was conducted to identify the magnitude of anemia and associated factors among drought affected children aged 6-59 months. It revealed that, 48.3.3% of children were anemic. This is higher than WHO cut off points as major (severe) public health problem. [12] Likewise, it is also higher than the prevalence of anemia in Mexico, [18] Cuba [19] and Cameron, [20] EDHS national anemia prevalence. [8] Higher magnitude may be related to the difference in socio economic status. Again, it may be due to the fact that, most populations in a country with state of economic transitions have low purchasing power for foods rich in iron. [21] Moreover, it could be explained by the effects of drought on child nutritional status as the effect of drought on childhood anemia was documented in study conducted elsewhere. [13] Age is one of the most common biological factors determining the occurrence of anemia and other health outcomes. In this study, except for age group 36 to 47 months, there was a significant mean haemoglobin difference between lower age groups and children age 48 to 59 months(**P-value <0.001**).For example, children age 6-11 months had 0.44gm/dl,0.92gm/dl,1.39gm/dl and 1.9gm/dl of lower hemoglobin concentration compared to the older ages in increasing order. This shows, concentration of hemoglobin increases as age of the children increase which means, anemia decreases as the age of the children increases. Hence, children age less than 12 months were at a greater risk of the consequence of anemia compared to older age categories. [22] This finding is consistent with the finding in Latin America, [23] China, [24] EDHS national study and study in Northern Ethiopia. [8,25] The higher prevalence among younger children is, related to their rapid growth which increases

iron demand at earlier life stage. [26] It may also be related to the contents of complementary foods such as cereal porridge fed to infants and young children in developing countries are poor sources of iron. [21]

In this study, children living in rural areas were more anemic as evidenced by their lower mean haemoglobin concentration [10.51gm/dl]compared to the mean haemoglobin concentration of urban children [11.19gm/dl]. The mean haemoglobin concentration of rural children was about 0.7gm/dl lower than that of urban children [P-value=<0.01,CI:-1.07,-0.29]. The higher prevalence of anemia may be explained by the higher proportion of rural children participated in this study. It may also be related to lack of basic needs and awareness about nutritional deficiencies in rural areas. In addition, it may be related to the impacts of drought which affected the study area during the study period. [9]

According to some studies, maternal education level is inversely associated with their children nutritional status. [27,28] In this study, there was significant association between level of maternal education and childhood anemia. Accordingly, children of mothers with no education were more anemic than children of mothers who attended primary and above educational level. The higher prevalence of anemia among children of mothers with no education was also found in the study done in Brazil, [21] Ghana, [29] Yemen [30] and study done in Northern Ethiopia (Tigray). [25] This can be attributed to the fact that, uneducated mothers were not more conscious of their children`s health and introducing scientifically recommended feeding practices which improve nutritional status. [31] Thus, knowing mothers` education level as important determinant factor of anemia helps in designing educational activities that increase awareness about feeding their children to prevent anemia and other nutritional problems.

Under nutrition is a combination of combination of macro and micro nutrient deficiencies. In this study, children nutritional status was assessed for which, stunting was found to show significant association with anemia. Accordingly, stunted children were more anemic compared children who were not stunted. The correlation of anemia and physical development among children was documented in some studies. [32,33]

Another important factor associated with anemia was vaccination history. It was observed that, being vaccinated found to be a protective factor against child hood anemia by 90%.Vaccination improves child health through various mechanisms including reducing the frequency of illness. The benefit of immunization against child hood under nutrition including anemia was revealed in some studies. [34,35]

5.1. Strengths

The response rate is hundred percent and collection of primary data by studying at community level mixing hemoglobin measurements and nutritional assessments during draught season. The finding showed the burden of anemia, vulnerable groups and risk factors.

5.2. Limitations

Most of the questions asked might be subject to recall bias. Causes of anemia (e.g., infections and other diseases), were based only on family reports and difficult to verify. The study only identified the prevalence of anemia, but cannot differentiate anemia types. Another limitation is, it cannot provide cause and effect relationships.

CONCLUSIONS

The prevalence of anemia was found to be a severe public health problem. Child age, place of residence, maternal educational, stunting and vaccination history of the children were important determinants factors of anemia among children aged 6–59 months. Nutritional activities targeting micronutrient

intervention should focus on young, rural areas, children of uneducated mothers and stunted children.

Competing interests

The authors declare there is no conflict of interest

Authors' contributions

Haji Aman designed the research conception, conducted the research, analysed the data and wrote the final report. Shimeles Ololo and Ashenafi Habtamu have provided advisory support during the whole research processes, edited and critically evaluated the final report. All authors have read and approved the manuscript

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