# Prevalence and associated factors of anemia among children aged 6-59 months in Ethiopia: Evidence from the Ethiopia Demographic and Health Survey

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# Abstract

Anemia is one of the most widely spread public health problems, especially in developing countries including Ethiopia. Thus, the aim of this study was to assess the prevalence and associated factors of anemia among children aged 6-59 months in Ethiopia. This study utilized secondary data from the 2016 Ethiopia Demographic and Health Survey. The data were analyzed using by STATA software version 14. Ordinal logistic regression statistical analysis was used to identify risk factors of anemia. Out of 8385 children considered in this study, more than half (57.3%) of them were anemic: 262(3.1%) were severely anemic, 2447(29.2%) were moderately anemic, and 2100(25.0%) were mildly anemic. Mothers' anemic status and children anemic status were highly associated. Accordingly, among severely anemic mothers, 26.8% of children were severely anemic, among moderately anemic mothers, 39.7% of children were moderately anemic. Mother's anemic status, place of residence, child age, smoking status, religion, and region of residence were factors associated with a prevalence of childhood anemia. A of anemia among children aged 6-59 months in Ethiopia was a severe public health problem. Thus, creating awareness among mothers how to control and manage the anemia status of their children and Routine iron supplementation are recommended to reduce childhood anemia.


# Background

Anemia is one of the common blood disorders and at least 1.62 billion people are affected by anemia globally[1]. Approximately two-thirds of preschool children in Africa and Southeast Asia were anemic[1]. According to the WHO report, more than half of the world's preschool-age children (56.3%) reside in countries where anemia is a major public health problem[2].

In Ethiopia, more than four out of ten children under five (44%) were anemic[3]. From these, about 21% of children were mildly anemic, 20% were moderately anemic, and 3% were severely anemic. Prevalence of anemia among children aged 6–59 months in Ethiopia is a severe public health problem, where 42.8% of the anemic and based on WHO criteria greater than 40% are categorized under severe public health problem[4]. The overall prevalence of anemia among children aged 6–59 months is 28.6%. The prevalence of mild, moderate, and severe anemia was 124(17.5%), 73(10.3%), and 5(0.7%), respectively[5].

Even though the Health Sector Development Program four(HSDP IV) target is to reduce anemia prevalence nationally by 12%, still anemia affected children at an early age in Ethiopia[6]. The local government statistics estimate the prevalence of anemia but does not take any action to control and manage anemia in children. Thus, the aim of this study was to determine the factors of anemia among children aged 6–59 months and to assess the effects of mother anemia on their children.

# Methods

*Source of data*

The study used data from Ethiopia Demographic and Health Survey 2016 data (EDHS 2016). It was conducted by the Ministry of Health (MOH) and implemented by the Central Statistical Agency (CSA).

*Study variable*

The dependent variable for this study was the anemia status of the children (none-anemic, mild, moderate and severe). Demographic and socioeconomic status, the health status of mothers and their children, residence area and diversity were independent variables of this study.

*Weighting the sample*

This study applied sample weight in order to compensate for the unequal probability of selection between the strata. The details descriptions of the weighting technique were found in the Demographic and Health Survey Methodology report.

*Statistical method*

This study employed an ordinal logistic regression (OLR) model to identify risk factors of anemia among children aged between 6–59 months. Since the dependent variable was ordinary(anemia status of children), an OLR model-proportional odds model (POM) was developed to find predictors of none, mild, moderate and severe anemia level.

The logit or log-odds of having Pr (Y≤i) = πi is modeled as a linear function of the explanatory variables as:

$$\log\left[\frac{\Pr(Y\leq i)}{1-\Pr(Y\leq i)}\right] = \log\left[\frac{\pi_i}{1-\pi_i}\right] = \alpha_i + \beta_1 x_1 + \cdots + \beta_p x_p \qquad (1)$$

Equivalent with

$$\left[\log\left[\frac{\pi_i}{1-\pi_i}\right] = \alpha_i + \sum_{j=1}^{p} \beta_j x_j;\ 0\leq\pi_i\leq 1;\ \text{therefore}\right.$$

$$logit[p_r(Y \leq i)] = \alpha_i + \sum_{j=1}^{p} \beta_j x_j \text{ i=1… c-1and j=1… p} \qquad (2)$$

# Odds ratio

The odds ratio is a value which measures the strength of the effect of each independent variable in the model on the log odds of the dependent variable (anemia status of children).

The odds of anemia in children is defined as the ratio of the number of anemic children to the number of none anemic children. That is, the odds of the anemic is given by:

$$\text{Odds (anemic status children)} = \frac{\Pr(\text{anemic children})}{\Pr(none\ anemic)} = \frac{\Pr(\text{anemic children})}{1-\Pr(\text{anemic children})} \quad (3)$$

The odds of the response are multiplied by eβ for every unit increment of x.That is the odds at level x+1 equal the odds at x multiplied by eβ and odd less than one indicates the occurrence is less likely than nonoccurrence. Analyses were performed using the STATA version 14 software and data organization was done using SPSS version 23.

# Results

Eight thousand three hundred eighty-five children were included in this study and the prevalence of anemia among children (6–59 months) was 57.3%. About 2791(47.6%) none-anemic children were born to none-anemic mothers and 1738(68.9%) anemic children were born to anemic mother.

The prevalence of anemia differs across regions of Ethiopia. Somali and Afar regions had the highest prevalence of anemia compared to the other regions and these regions are developing regions of Ethiopia. Fig 1 indicates that the prevalence of anemia among children living in the Somali region was 83.1%. The prevalence of anemia among children in the Afar region of Ethiopia was found to be 74.4 %. This indicated that the developing regions of Ethiopia have the highest prevalence of anemic children that developed a region of Ethiopia. Therefore, the developing region of Ethiopia was highly affected by anemia.

The prevalence rate of anemia in Dire Dawa and Harar was 71.1% and 66.7 %, respectively. Based on this research, the eastern part of Ethiopia was highly affected by anemia (Fig 1). Fig 1 (given on separated file) shows the distribution of anemia by region in Ethiopia.

*Factors associated with children's Anemia*

Ordinal logistic regressions analysis was used to identify the factors associated with anemia among children of 6–59 months. Among the factors that considered in this study, mother anemic status, wealth status, child age, smoking status, religion, and region of children were significantly associated with anemia among children(6–59 months) at 5% level of significance. A region of children who live in rural, who have to believe other religion mothers, anemic mother, and lower-age- were more likely to have anemia children than urban a place of residence, who have to believe orthodox religion mothers, none anemic mother, and high age children.

Children of a moderately anemic mother were 3 times more likely to develop an anemic compared to children of none anemic mothers. Table 1 shows that children of the mild anemic mother were 1.98 times more likely to develop to anemia compared to children of none anemic mother.

The log odds of anemic children whose region was Somali increased by 5.73. Table 1 shows that Somali region children were 5.73 times more likely to develop anemia than those children who live in the Tigray region. The children who live in a developing region were more affected by severe anemia, moderate

anemia and mild anemic compared to the developed region of Ethiopia. As the age of the children increased by a month, the odds of having anemia were decreased by 0.957.

The study shows that the religious affiliation of the child was also found to be significantly associated with children anemia status. The likelihood of being at higher anemia level of other religion was 16.33 times more likely compared to the orthodox religious affiliation of the child.

**Table 1.** The result of the Ordinal Logistic Regression Model for Child Anemia Level (EDHS, 2016).

| Variables | Category | unadjusted Odds Ratio | Adjusted Odds Ratio [95% Conf. Interval] | P-value |
|---|---|---|---|---|
| Mother's anemia status | Not anemic (ref) | | | |
| | Mild | 1.922774 | 1.98276 [1.206979, 3.25717] | 0.007 |
| | Moderate | 2.804522 | 3.006825 [1.339789, 6.748078] | 0.008 |
| | Severe | 5.14395 | 3.663031 [0.502884, 26.6817] | 0.200 |
| Region | Tigray | | | |
| | Afar | 2.430192 | 2.162583 [0.7586726,6.164406] | 0.149 |
| | Amhara | .6496319 | .7539568 [0.394442,1.441152] | 0.393 |
| | Oromia | 1.567293 | 1.667998 [0.7170414,3.880137] | 0.235 |
| | Somali | 4.721315 | 5.73259 [1.855245, 17.71334] | 0.002 |
| | Benishangul | .6512202 | .5530813 [0.2195138,1.393529] | 0.209 |
| | SNNPR | .9006993 | 1.884041 [0.8468091,4.191747] | 0.121 |
| | Gambela | 1.301803 | .666065 [0.2583753,1.717047] | 0.400 |
| | Harari | 1.877887 | 3.877902 [1.307043, 11.50546] | 0.015 |
| | Addis Adaba | .8804848 | 1.011938 [0.3108083,3.294693] | 0.984 |
| | Dire Dawa | 2.659204 | 6.847532 [1.882913, 24.90221] | 0.003 |
| Types of a place of Residence | Urban (ref) | | | |
| | Rural | 1.369735 | 1.8397178 [1.3843039,1.834814] | 0.041 |
| Children's Gender | Male | | | |
| | Female | 0.9452458 | 1.030642 [0.6849999,1.550692] | 0.885 |
| Cough | No | | | |
| | Yes, last two weeks | 1.090227 | 0.768809 [0.5085323, 1.1623] | 0.212 |
| Child Age(Month) | | 0.9680009 | 0.9577865 [0.9416271,0.9742231] | 0.000 |
| Diarrhea By drink water | No(ref) | | | |
| | yes | 0.7726368 | 0.5575183 [0.2314672,1.342854] | 0.193 |
| Diarrhea eat | No(ref) | | | |
| | yes | 1.196465 | .6867334 [0.3532547,1.335022] | 0.268 |

| | | | | |
|---|---|---|---|---|
| Wasting cat(ref) | | | | |
| | Nourished | | 0.9048862 [0.5449983,1.502425] | 0.699 |
| Stunting Cate(ref) | | | | |
| | Nourished | | 0.6244834 [0.3186723,1.223763] | 0.170 |
| Underweight ( ref) | | | | |
| | Nourished | | 1.033828 [0.5184922,2.061361] | 0.925 |
| Mother's educational level | No education (ref) | | | |
| | Primary, secondary or higher | 0.7363796 | 0.7641587 [0.4714281,1.238659] | 0.275 |
| Birth order number | 1(ref) | | | |
| | 2-3 | 0.910856 | 1.413815 [0.6299757,3.172937] | 0.401 |
| | 4-5 | 0.7924922 | 0.6994087 [0.3327923,1.469903] | 0.345 |
| | 6+ | 0.8570837 | 1.099869 [0.613743, 1.971039] | 0.749 |
| Wealth | Poor | | | |
| | Middle and Rich | 0.5392279 | 0.2876902[0.2031319,0.733187] | 0.0029 |
| Smoking cigarette status | No | | | |
| | Yes | 0.8845601 | 0.0017373 [0.0000839,0.0359848] | 0.000 |
| Birth Interval(Months) | | | 0.9960359 [0.9851917,1.006999] | 0.477 |
| Religion | Orthodox | | | |
| | Catholic | 1.192936 | 1.40402 [0.4606575 4.27926] | 0.551 |
| | Protestant | 1.327873 | 0.8118799 [0.3561876,1.850567] | 0.620 |
| | Muslin | 2.742431 | 1.239876 [0.5753094,2.672116] | 0.583 |
| | Traditional | 1.724152 | 0.9676995 [0.0906113,10.33472] | 0.978 |
| | Other | 2.08334 | 16.33936 [1.886106, 141.548] | 0.011 |
| /cut1 | | | -2.751443 | |

| | |
|---|---|
| | [-4.406491,-1.096396] |
| /cut2 | -1.361519 [-2.970286,.2472483] |
| /cut3 | 1.84438 [.2355683, 3.453191] |

# Discussions

This study was intended to identify the factors of anemia among children aged 6- 59 months using the 2016 EDHS data set. Accordingly, the ordinal logistic regression technique was employed to determine the prevalence and identify the risk factors of anemia and explore the association between mother and child's anemia.

The prevalence of anemia was found to be 57.3% in this study. According to this study, child anemia was associated with mother's anemia status. This was mainly due to the lower consumption of home iron due to poverty [7]. It is better for households to have better access to food and higher cash incomes, allowing them a quality diet and better access to medical care. This finding was supported by a study done by[7, 8]. According to [9], the percentage of children with anemia was significantly higher among low-income families. Many previous studies indicated that poverty was one of the significant factors of anemia [10]. Poverty was directly related to the anemic status of children and the family economic status determined the anemic status of the children. Improving the economy of the households in the rural region of Ethiopia will be able to control and manage the anemic status of children.

The place of residence of children was a statistically significant factor for the anemic status of children in this study. The result of this study showed that the prevalence of anemia among the children living in urban and rural was different and the difference was statistically significant. The children who live in a rural area were highly affected by anemia than urban children. This might be due to the fact that populations that live in rural areas and in the border of urban centers, because of joblessness, low wages, poor housing, education, and health conditions, are the ones that are at higher risk for anemia. The finding of this study was in line with other studies [11, 12]

Fig 1 in this study showed that that the prevalence of anemia at the Addis Ababa city administration compared to the Ethio-Somali region was quite different(12,13).

The prevalence rate of anemia was higher among early aged child increased in a month and a similar finding has reported [13]. The studies in which children are assessed according to age show a higher prevalence of anemia in children aged between six and 24 months[14]. Iron requirements are related to growth velocity and so requirement per kg of bodyweight decrease with age. Therefore, there may be a physiological explanation for the fall in anemia prevalence with age. Iron intakes are also likely to important with age as a result of a more varied diet. The odds of being severe, moderately or mild anemic were higher for children who have smoker mother. This result agreed with the previous study in Ethiopia[15].

# Conclusions

The aim of this study was to explore the risk factor of anemia in children aged between 6–59 months in Ethiopia. The result of ordinal logistic regression (OLR) model indicated that the major causes of anemia among children were residence place (rural), economic status (poor), anemia status of the mother and age of children (early-age). The prevalence of anemia among children in Ethiopia was 57.3%. Hence, the concerned body should create awareness among mothers how to control and manage the anemia status of their children. Routine iron supplementation should be encouraged in the country. Finally, health education consultations on nutrition need for the mother/children and raising children should be supported by iron-rich foods.

# Abbreviation

EDHS: Ethiopia demographic and health survey, CSA: central statistics agency CI: confidence interval; OLR, ordinal logistic regression OR: Odds ratio; PPOM: Partial Proportional Odds Model; PPOM-R: Partial Proportional Odds Model-With Restrictions, HSDPT IV: Health Sector Development Program IV.

# Declarations

I declare that this manuscript is my/our original work and it is submitted for first publication toMC Public Health - Journal. The manuscript has not been published and is not being submitted or considered for publication elsewhere.

*Ethics approval and consent to participate*

The ethical clearance for the survey was approved by the Ethical Review Board of Ethiopia Central Statistical Agency (CSA) and all participants who agreed to take part in the survey signed a consent form. The data collection procedure was anonymous for keeping the confidentiality of any information

*Acknowledgment*

Not Applicable

*Authors' Contributions*

*Conceptualization:* AA W

*Data Curation:* AAW, AKT

*Formal Analysis:* AAW

*Investigation:* AAW, AKT

*Methodology:* AAW, AKT

*Project Administration:* AAW

*Software:* AAW, AKT

*Supervision:* AAW, AKT

*Validation:* AAW, AKT

*Visualization:* AAW, AKT

*Writing- Original Draft Preparation:* AAW

*Writing -Review & Editing:* AAW, AKT

All authors have read and approved the manuscript

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*Consent for publication*

Not Applicable

# References

1. WHO: Global anaemia prevalence and number of individuals affected. 1 (2008)
2. (WHO), W. H. O.: The Global Prevalence of Anemia in. (2019)
3. EDHS, 2005: Ethiopia Demographic and Health Survey, 2000. 1–5 (2001). doi:978–92–1–101320–7
4. Kawo, K. N., Asfaw, Z. G., Yohannes, N.: Multilevel Analysis of Determinants of Anemia Prevalence among Children Aged 6–59 Months in Ethiopia: Classical and Bayesian Approaches. Anemia. 2018, (2018). doi:10.1155/2018/3087354
5. Melku, M., Takele, W. W., Anlay, D. Z., Ekubagewargies, D. T., Getaneh, Z., Abebe, M., Abebe, Z.: Male and undernourished children were at high risk of anemia in Ethiopia: A systematic review and meta-analysis. Ital. J. Pediatr. 44, 1–11 (2018). doi:10.1186/s13052–018–0513-x
6. Ethiopian FMOH: Health Sector Development Program: 2010/11 –2014/15. Fed. Democr. Repub. Ethiop. Minist. Heal. IV, 1–131 (2010). doi:10.1093/jmp/jht077
7. Semedo, R. M. L., Santos, M. M. A. S., Baião, M. R., Luiz, R. R., Da Veiga, G. V.: Prevalence of Anaemia and Associated Factors among Children below Five Years of Age in Cape Verde, West Africa. J. Heal. Popul. Nutr. 32, 646–657 (2014)
8. Pollitt, E.: The Developmental and Probabilistic Nature of the Functional Consequences of Iron-Deficiency Anemia in Children. J. Nutr. 131, 669S–675S (2001). doi:10.1093/jn/131.2.669S

9. Dissertation, A.: Prevalence and Risk Factors of Anemia among Children in GeziratelfeelDistrict, Wad Madani, Gezira State, Sudan. (2018)
10. Baxter, R., Hastings, N., Law, A., Glass, E. J..: The economic impact of anaemia in Peru. Lima: Group for the Analysis of Development and Action Against Hunger. (2008)
11. Osório, M. M., Lira, P. I. C., Filho, M. B.: Prevalence of anemia in children 6–59 months old in the state of Pernambuco, Brazil. 1–11 (2018)
12. Muchie, K. F.: Determinants of severity levels of anemia among children aged 6–59 months in Ethiopia: further analysis of the 2011 Ethiopian demographic and health survey. BMC Nutr. 2, 1–8 (2016). doi:10.1186/s40795–016–0093–3
13. Soh, P., Ferguson, E. L., McKenzie, J. E., Homs, M. Y. V, Gibson, R. S.: Iron deficiency and risk factors for lower iron stores in 6–24-month-old New Zealanders. Eur. J. Clin. Nutr. 58, 71–79 (2004). doi:10.1038/sj.ejcn.1601751
14. Karr, M., Alperstein, G., Causer, J., Mira, M., Lammi, A., Fett, M. J.: Iron status and anaemia in preschool children in Sydney. Aust. N. Z. J. Public Health. 20, 618–622 (1996). doi:10.1111/j.1467–842X.1996.tb01076.x
15. Ezzat, D., Barakat, A., Nada, K.: Prevalence and determining factors of anemia and malnutrition among egyptian children. Indian J. Med. Sci. 67, 168 (2014). doi:10.4103/0019–5359.125878

# Figures

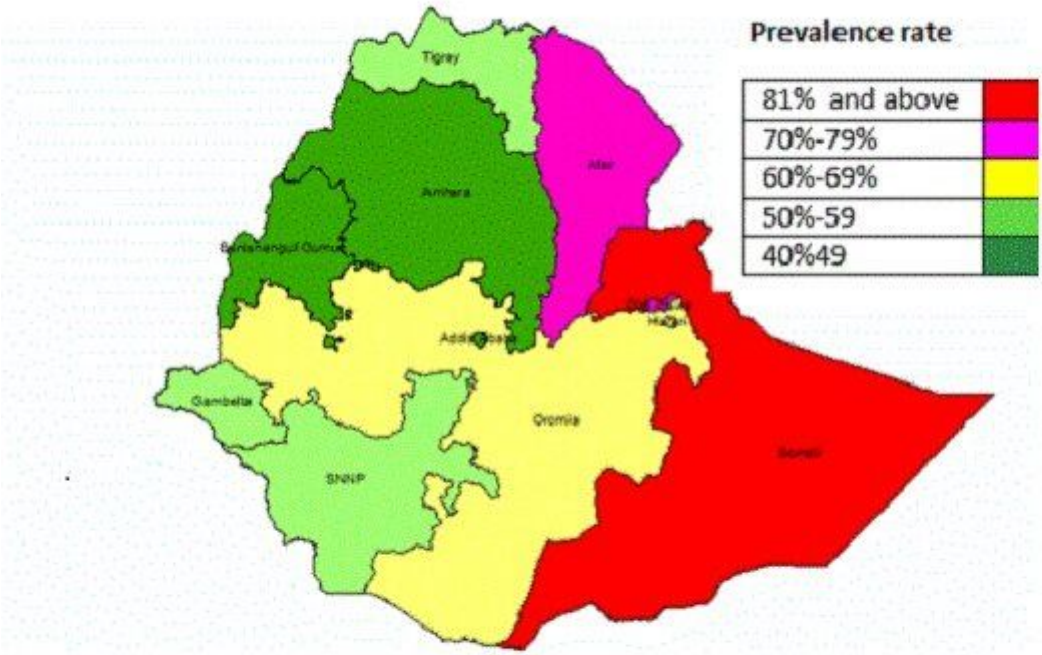


**Figure 1. Distribution of childhood anemia by region in 6-59 months child in Ethiopia**

**Figure 1**

Distribution of child hood anemia by region in 6-59 months child in Ethiopia