ORIGINAL RESEARCH ARTICLE

Maternal Risk Factors for Childhood Anaemia in Ethiopia

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Abstract

A total of 8260 children between the ages of 6-59 months were analyzed to identify the risk factors associated with childhood anaemia in Ethiopia. The overall mean (SD/ standard deviation) haemoglobin (Hgb) level among the under-five children was 10.7 (2.2) g/dl and 50.3% were anaemic. Childhood anaemia demonstrated an increasing trend with maternal anaemia levels of mild, moderate and severe anaemia: odds ratio of 1.82, 2.16 and 3.73 respectively ($p < 0.01$). Children whose mothers had no formal education were 1.38 times more likely to be anaemic ($p<0.01$). The poorest and poorer wealth index groups had 1.52 and 1.25 increased odds of childhood anaemia respectively ($p < 0.01$). Childhood anaemia in Ethiopia is a severe public health problem. Maternal anaemia and socio-economic status were found to be associated with anaemia in children. A holistic approach of addressing mothers and children is of paramount importance. (*Afr J Reprod Health 2013; 17[3]: 110-118).*

Résumé

Un total de 8260 enfants âgés de 6-59 mois ont été analysés afin d'identifier les facteurs de risque associés à l'anémie de l'enfance en Ethiopie. La moyenne (type SD / écart standard) hémoglobine niveau global (Hgb) chez les enfants qui ont moins de cinq ans était de 10,7 (2,2) g / dl et 50,3% étaient anémiques. L'anémie de l'enfance a démontré une tendance à la hausse des niveaux d'anémie maternelle de l'anémie légère, modérée et sévère: odds ratio de 1,82, 2,16 et 3,73 respectivement ($p <0,01$). Les enfants dont les mères n'avaient pas été scolarisées étaient 1,38 fois plus susceptibles d'être anémiques ($p <0,01$). Les groupes de l'indice de richesse les plus pauvres et les moins pauvres avaient 1,52 et 1,25 probabilité accrue d'anémie infantile, respectivement ($p <0,01$). L'anémie chez les enfants en Éthiopie est un problème de santé publique grave. L'on a découvert que l'anémie maternelle et la situation socio-économique ont été associées à l'anémie chez les enfants. Une approche holistique pour s'occuper des mères et des enfants est d'une importance primordiale. (*Afr J Reprod Health 2013; 17[3]: 110-118).*

Keywords: Maternal, anaemia, child, risk factor, Ethiopia

Introduction

Anaemia is one of the most common nutritional problems affecting vulnerable population groups including pre-school children. The WHO database (1993-2005) reported the global prevalence of anaemia among pre-school children to be 47.4% affecting over 293 million children. The prevalence of anaemia among African children in the same report was 64.7%, carrying one-third of the global burden[1]. Infants and younger children were found to have higher level of anaemia than older children[2-5]. The prevalence of anaemia in Ethiopian children under five has been reported as being between 42% and 75.2%[1,5-7].

Dietary iron deficiency, infectious and hereditary diseases, and other nutrient deficiencies are among the causes of childhood anaemia[8-12]. More than half of the anaemia burden is ascribed to iron deficiency. Iron deficiency is believed to be related to deficient bio-available iron or increased iron demand of child growth and development[3,4,13,14]. The primary causes of childhood anaemia were seen to be linked with a number of underlying risk factors including: socio-economic status, environmental factors, food intake, child feeding practices, child age and maternal nutritional status[5,10,15-17].

Iron deficiency during infancy and early childhood has a multitude of adverse consequences on cognition, child development, behavior, health status, perinatal mortality and child mortality[18-24]. Evidence-based public health interventions will need to be fully considered in order to help tackle the detrimental effects of anaemia on children. The main risk factors have to be identified and their contribution in the causation of anaemia assessed. This analysis estimates the prevalence of anaemia among under-five children in Ethiopia and examines maternal and child characteristics that may influence anaemia among children.

Methods

Data

Data for this study was drawn from the third Ethiopian Demographic and Health Survey - 2011 (EDHS). The survey was implemented by the Central Statistics Authority, Ethiopia with the technical support of ORC Macro. The survey collected information from a nationally representative sample of 16702 households, 16515 women (15-49 years), 15908 men (15-59 years) and 11569 children under-five.

The EDHS covers all the administrative regions (nine regional states and two city administrations) in the country. In 2011 the EDHS recorded data relating to: family planning; fertility levels and determinants; fertility preferences; infant, child, adult and maternal mortality; maternal and child health; nutrition; women's empowerment and knowledge of HIV/AIDS. An advantage of the EDHS dataset is that individual records of household, parents and children are available, thus permitting a detailed analysis. The 2011 EDHS data provides information on anaemia among under-five children and possible related factors in mothers and households.

Variables

Dependent variable: Anaemia among children aged 6-59 months

Anaemia is identified by measuring the haemoglobin level (g/dl) in blood. Children are classified as having mild, moderate or severe anaemia depending on the adjusted haemoglobin levels for different altitudes. For the current analysis, child anaemia was dichotomized to any anaemia (mild, moderate and severe) and normal.

Independent variables:

1. Child: Age, Gender, Wasting, Iron intake, Anthelmintic treatment in the previous six months, Vitamin-A intake, DPT-3 vaccination
2. Mother: Age, Education, Anaemia
3. Household: Residence, Family size, Wealth index

Anaemia testing

Blood samples were taken from all children in the age group 6-59 months and women 15-49 years who gave consent for haemoglobin testing. A drop of blood from a finger prick or a heel prick was collected in a microcuvette. A battery operated portable Hemacue analyser was used to measure haemoglobin concentration. Children and women with low haemoglobin levels were advised to visit nearby health facilities for medical care. A brochure explaining the causes and prevention of anaemia was given to all households in which haemoglobin testing was conducted.

Definitions of variables

1. Anaemia in children: Mild anaemia (Hgb 10-10.9 g/dl), moderate anaemia (Hgb 7-9.9 g/dl) and severe anaemia (Hgb less than 7 g/dl).
2. Anaemia in women: Pregnant: mild anaemia (Hgb 10-10.9 g/dl), moderate anaemia (Hgb 7-9.9 g/dl) and severe anaemia (Hgb less than 7 g/dl).

   Non-pregnant: mild anaemia (Hgb 10-11.9

g/dl), moderate anaemia (Hgb 7-9.9 g/dl) and severe anaemia (Hgb less than 7 g/dl).

3. Wasting: Children with Z-scores of weight-for-height index below minus two standard deviations (SD) are considered wasted or acutely malnourished.

Analysis:

The analysis included 8260 observations (in children's dataset) with complete information on the dependent and independent variables. Percentage and mean were used to describe the level of anaemia. Bivariate analysis in terms of Chi-square test and multivariate analysis in terms of binary logistic regression have been used. Predictor variables with p-value less than 0.3 in the bivariate analysis were included in the multivariate analysis to control for possible confounding factors. Stepwise binary logistic regression (Backward method) model was developed, and Odds Ratio with 95% Confidence Interval was computed to describe the association of risk factors with childhood anaemia. Statistical significance was defined as p-value less than 0.05. SPSS software (version 20.0) and Epi Info Version 3.5.3 were used in the analysis of the data.

Detailed information on the study area, study population, organization of the survey, sample design, questionnaires, data collection, data quality, data processing, anaemia testing, anthropometry measurement and ethical issue is published in the Ethiopian Demographic and Health Survey 2011 report[25].

The primary author communicated with MEASURE DHS/ ICF International and permission was granted to download and use the data for this project.

Results

Data on 8260 – 33% respectively children between the ages of 6-59 months were included in the analysis. The mean (SD) age of the children was 32.5 (15.5) months. The male to female ratio of the children was 1.05 with urban and rural representation of 15% and 85%, respectively. The nutritional status of more than 75% of the children were in the wasted range. The age range of their mothers was between 15 and 49 years with.

The mean age (SD) of 29.4 (6.6) years. More than two-thirds of the mothers had no formal education and 23.7% were anaemic. The wealth index for households was poor, middle and rich for 50%, 17% and 33% respectively.

The mean (SD) haemoglobin level among the under-five children was 10.7 (2.2) g/dl. A total of 4157 (50.3%) were found to be anaemic (Hgb below 11 g/dl). The number of children with severe anaemia was 294 (3.6%). The prevalence of anaemia was found to be significantly related to child age, child nutritional status, DPT-3 vaccination uptake, recent Vitamin-A intake and recent anthelmintic treatment history (Chi-square p-values less than 0.05). Child gender and recent iron supplementation did not affect the prevalence of anaemia (Figure 1 and Table 1).

Table 1: Distribution of anemia prevalence among the under-five children by child background characteristics, Ethiopia, 2011

Variables	**Total number**	**Anemia Prevalence (%)**	**95% Confidence Interval**
Overall	**8260**	**50.3**	**(49.2, 51.4)**
Variables	**Total number**	**Anemia Prevalence (%)**	**95% Confidence Interval**
Child age in months		*	
6-11	915	68.5	(65.4, 71.5)
12-23	1704	63.3	(61.0, 65.6)
24-35	1825	52.4	(50.1, 54.7)
36-47	1956	42.8	(40.6, 45.0)
48-59	1860	35.3	(33.2, 37.6)
Child gender			
Male	4227	50.4	(48.9, 52.0)

Female	4033	50.2	(48.7, 51.8)
Child nutritional status		*	
Wasted	6488	51.4	(50.2, 52.7)
Not-wasted	1772	46.2	(43.9, 48.6)
Vitamin A given in last 6 months		*	
Yes	4472	46.6	(45.2, 48.1)
No	3788	54.7	(53.1, 56.3)
DPT 3 vaccinated		*	
Yes	3167	45.4	(43.7, 47.2)
No	5093	53.4	(52.0, 54.7)
Iron supplementation			
Yes	769	49.5	(46.0, 53.1)
No	7491	50.4	(49.3, 51.5)
Anthelmintic intake in 6 months		*	
Yes	1720	42.6	(40.2, 44.9)
No	6540	52.4	(51.2, 53.6)
Overall	**8260**	**50.3**	**(49.2, 51.4)**

**p< 0.05 (Chi-square test for % difference)*

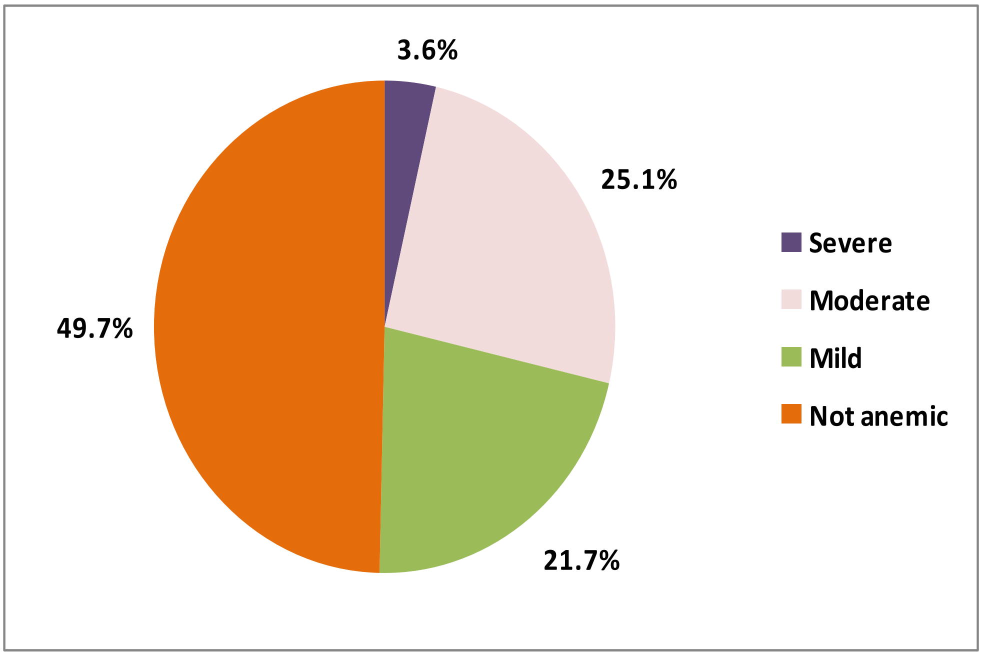

Figure 1: *Prevalence of mild, moderate and severe anemia in the total under-five children sample (n=8260), Ethiopia, 2011.*

Family related variables: residence, maternal age, maternal education, maternal anaemia and family wealth index were found to have significant differences in the percentage distribution of anaemia (Chi-square p-values less than 0.05). There was no statistically significant difference of anaemia distribution in relation to the number of household members (Table 2).

Table 2: Distribution of anemia prevalence among the under-five children by family background characteristics, Ethiopia, 2011

Variables	**Total number**	**Anemia Prevalence (%)**	**95% Confidence Interval**
Residence		*	
Urban	1238	43.4	(40.6, 46.2)
Rural	7022	51.6	(50.4, 52.7)
Maternal age in years		*	
15-19	300	61.7	(55.9, 67.2)
20-24	1563	50.5	(48.0, 53.1)
25-29	2594	49.6	(47.7, 51.6)
30-34	1749	51.6	(49.3, 54.0)
35 & above	2054	48.3	(46.1, 50.5)
Maternal education		*	
No education	5857	52.7	(51.4, 54.0)
Primary	2046	45.7	(43.5, 47.8)
Secondary & above	357	38.4	(33.3, 43.7)
Maternal anemia		*	
Non-anemic	6304	46.4	(45.2, 47.7)
Mild anemia	1368	61.3	(58.7, 63.9)
Moderate anemia	500	64.8	(60.4, 69.0)
Severe anemia	88	76.1	(65.9, 84.6)
Family wealth index		*	
Poorest	2586	57.7	(55.8, 59.6)
Poorer	1552	51.2	(48.7, 53.7)
Middle	1365	46.5	(43.9, 49.2)
Richer	1373	46.8	(44.2, 49.5)
Richest	1384	42.8	(40.2, 45.4)
No of household members			
2-5	3561	48.8	(47.1, 50.4)
6-10	4379	51.6	(50.1, 53.1)
11 & above	320	50.6	(45.0, 56.2)
Overall	**8260**	**50.3**	**(49.2, 51.4)**

**p< 0.05 (Chi-square test for % difference)*

All the relevant child and family related variables except DPT-3 uptake were included in logistic regression analysis. DPT-3 uptake was excluded from logistic regression analysis to avoid multi-collinearity with the variable Vitamin-A intake. The variables included in the final model of the logistic regression analysis were household wealth index, maternal education, maternal anaemia, number of residents in a household, age of child, nutritional status, Vitamin A intake and recent anthelmintic treatment. Maternal age and urban/ rural residence status were not retained in the final model.

Childhood anaemia demonstrated an increasing trend with the severity of maternal anaemia of mild, moderate and severe anaemia: odds ratio of 1.82, 2.16 and 3.73 respectively ($p < 0.01$). Children whose mothers had no formal education were 1.38 times more likely to have childhood anaemia ($p = 0.012$). There was no difference in rates of childhood anaemia in children whose mothers completed primary versus secondary or above education levels. Compared to the children from the richest wealth index, children from the poorest and poor wealth index groups had 1.52 and 1.25 times increased odds of childhood anaemia respectively. Middle and richer wealth index groups did not demonstrate any significant difference (Table 3).

The odds of childhood anaemia demonstrated progressively decreasing trend with increasing child age. As compared to age group 6-11months, those in the age groups 12-23 months had 18% reduction in anaemia ($p = 0.022$). The reduction in the chance of childhood anaemia in the age groups 24-35 months, 36-47 months and 48-59 months of age was by 50%, 67% and 77% respectively. Children with nutritional status in the wasted category had a 13% increased likelihood of anaemia (p=0.034). The likelihood of anaemia among children with no reported Vitamin-A intake in the previous six months increased by 24% as compared to those who received Vitamin-A (p< 0.01) (Table 3).

Table 3: Family and child factors predicting childhood anemia (Logistic regression analysis), Ethiopia, 2011

Variables	**β-coefficient**	**Adjusted Odds Ratio (95% CI)**	**p-value**
Maternal anemia level			
No anemia		1.00	
Mild anemia	0.60	1.82 (1.61, 2.07)	0.000
Moderate anemia	0.78	2.18 (1.78, 2.65)	0.000
Severe anemia	1.32	3.73 (2.25, 6.19)	0.000
Maternal education			
No formal education	0.32	1.38 (1.07, 1.78)	0.01
Primary	0.12	1.13 (0.88, 1.46)	0.34
Secondary & above		1.00	
No of household members			
2-5		1.00	
6-10	0.11	1.12 (1.02, 1.23)	0.02
11 & above	0.12	1.12 (0.88, 1.43)	0.35
Family wealth index			
Poorest	0.42	1.52 (1.31, 1.77)	0.000
Poorer	0.23	1.25 (1.06, 1.48)	0.007
Middle	0.01	1.01 (0.86, 1.20)	0.881
Richer	0.09	1.09 (0.92, 1.29)	0.307
Richest		1.00	
Child age in months			
6-11		1.00	
12-23	-0.20	0.82 (0.69, 0.97)	0.022
24-36	-0.70	0.50 (0.42, 0.59)	0.000
36-47	-1.12	0.33 (0.28, 0.39)	0.000
48-59	-1.45	0.23 (0.20, 0.28)	0.000
Child nutritional status			
Normal		1.00	
Wasted	0.12	1.13 (1.01, 1.26)	0.034
Vitamin A given in last 6 months			
Yes		1.00	
No	0.21	1.24 (1.12, 1.36)	0.000

Discussion

Childhood anaemia was shown to be a severe public health problem irrespective of urban residence, better wealth status or educational achievement. Despite the varying level of childhood anaemia with some background characteristics like residence, wealth index and maternal education, all categories had more than 40% anaemia prevalence. An anaemia prevalence of 40% or more is defined as a severe public health problem[1]. A Significant proportion of children had mild or moderate anaemia while a few fell in to the severe anaemia category. This high burden of anaemia calls for the recommendation of the Ethiopian national guideline for control and prevention of micronutrient deficiencies to provide iron supplements to children[26]. A similarly huge burden of anaemia has been documented in studies reported from Ethiopia and elsewhere[5,6,7,14,16].

The fact that older children had a lower prevalence of anaemia compared with their younger counterparts might be explained by the increasing introduction and toleration of iron containing adult food with age. Increasing age of children also decreases the chance of inter-current illness which may predispose to anaemia. The prevalence of anaemia was seen to differ between mothers (23.7%) and their children (50.3%). The difference can be ascribed to mothers' more diverse diet containing items rich in iron. Food items with high iron content such as cereals, vegetables and animal products might not be palatable to children or parents might withhold such foods believing that children may not tolerate them.

Education of mothers demonstrated a protective effect on childhood anaemia. This may be explained by the use of improved feeding and childcare practice by educated mothers. The children of mothers with a primary education level had comparable levels of anaemia to their counterparts whose mothers were educated to secondary level or above group. The educational level of mothers has been previously shown to decrease the prevalence of anaemia[16-18]. Children with mothers from poor households had statistically significant increased level of childhood anaemia. This finding has also been demonstrated in similar studies[16,17].

Pre-school children from poor backgrounds and/ or with poorly educated mothers may be more prone to anaemia due to inappropriate feeding practices, lack of nutrients, intercurrent illness and poor access to health services. This supports the public health value of the WHO Millennium Development Goals of universal primary education for women and eradicating poverty. The facts that more than a third of mothers were not educated, many were malnourished and more than half were poor demonstrates the degree of challenges to be overcome to enable effective and holistic public health measures related to iron deficiency to be implemented[16].

Vitamin-A supplementation, was found to reduce the risk of childhood anaemia. This may be explained by the direct effect of Vitamin-A on anaemia[27]. In addition care takers visiting health facilities for Vitamin A supplementation may also receive additional health information and nutritional advice when they visit health workers to obtain vitamins. The proportion of children with wasting and anaemia was over 50%. This signifies the enormity of nutritional deficiency in protein-energy in addition to micronutrients. In the management of protein-energy malnutrition, the evaluation and treatment of concurrent micro-nutrient deficiencies needs to be taken in to account. The increasing trend of childhood anaemia with mild, moderate and severe maternal anaemia indicates that nutritional deficiency is shared between caretakers and children. This inter-generational linkage of malnutrition has been previously reported[28].

Both male and female children had an equal chance of developing anaemia. There have been inconsistent findings from prior studies. An association of child gender with anaemia[18] has been reported while another did not reveal any association[16]. Increasing household size above ten was not associated with significant difference in childhood anaemia level. The expectation was that household food security and food diversity would be compromised with increasing family members with resultant decreased level of nutrient intake as was seen in a previous study[15]. Perhaps households with higher family size have more than one employed person that boosts the economic support at household level and hence improves food availability.

Recent treatment with drugs for intestinal parasites and iron intake did not demonstrate a significant impact on childhood anaemia. A randomized control trial in Ivory Coast also reported that iron supplementation did not have an impact on childhood anaemia[29]. Given the multiplicity of causes of anaemia in children, anthelmintic and iron supplementation might not be sufficient to improve haemoglobin levels. A number of other factors might also affect the reliability of the information relating to drug treatments. These would include: mothers might not distinguish between drug treatments (anthelmintic, iron or others), recall bias and the absence of complete information on the treatment doses.

The limitations of this study are that possible child-related explanatory variables such as food habit, child feeding practices, parasitic infection and chronic illness were not included in the analysis. Possibly relevant variables related to mothers such as gravidity, parity, birth interval and autonomy were not included. Nevertheless the data collected is robust due to the large sample size, representation of diverse population groups, wide geographic coverage, use of validated haemoglobin measurement method, and standardization of haemoglobin level for altitude. All these support the validity of the findings in this study.

Conclusion

Childhood anaemia in Ethiopia is a severe public health problem. Higher degree of maternal anaemia predisposes to childhood anaemia. Mothers' low educational background and poor household economic status were found to be associated with low haemoglobin levels in children. Established interventions such as Vitamin A supplementation are vital in the prevention of childhood anaemia. Identifying the root cause of anaemia and improving nutritional advice and supplementation will be required. Developing public health programs with a holistic approach to mothers and children is of paramount importance. Works to deliver the Millennium Development Goals to improve education for women and eradicate poverty are also likely to lead to significant reductions in childhood anaemia. Currently in settings with a high burden of anaemia, family level anaemia screening is advised on vulnerable groups if there is an index case of adult anaemia in the household.

Authors' contributions

DH, KA, MM, IM, TB, WA, GT, DA and SS contributed in the conception of analysis plan and interpretation of data.

DH was involved in the manuscript preparation and all others contributed in the critical review of the manuscript.

All authors approved the final version of the manuscript.

Competing interest

All the authors declare that there is no financial and non-financial competing interests related with the current study.

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