

BURDEN AND DETERMINANT FACTORS OF ANEMIA AMONG ELEMENTARY SCHOOL CHILDREN
IN NORTHWEST ETHIOPIA: A COMPARATIVE CROSS SECTIONAL STUDY

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Abstract

Background: Anemia is an indicator of both poor nutrition and health. In low-income countries like Ethiopia, the prevalence of anemia remains high due to several determinant factors. There is a lack of regular surveillance system to determine the magnitude of anemia among school age children. The aim of this study was to determine the burden and determinant factors of anemia among school children.

Materials and Methods: A comparative cross-sectional study was conducted from March 2014 to May 2014 among elementary school children in Northwest Ethiopia. Multi stage and simple random sampling techniques were used to select the schools and the study subjects. Standard questionnaire was employed to assess the socioeconomic status of study participants. Intestinal parasitosis infections and hemoglobin level were determined by formula ether concentration technique and automated hematology analyzer, respectively. Descriptive statistics were used to determine the burden of anemia. Stepwise logistic regression was used to identify the determinants of anemia.

Results: Among 2,372 elementary school children, the prevalence of anemia was 7.6% (95 % CI: 7% - 9%). The mean hemoglobin level was 11.6 g/dl ranging from 10 g/dl to 13g/dl. The magnitude of hookworm infection was 530 (22.3%). In multivariate analysis anemia was found associated with residence, source of water, availability of latrine, maternal education, family size and hookworm infection.

Conclusion: Anemia still remains as a major public health problem among the school children in the study area. Residence, source of water, availability of latrine, maternal education, family size and hookworm infection are also the major determinant factors for the high prevalence of anemia. Therefore, health education, iron supplement and deworming should be given to school age children.

Key words: Anemia, burden, Bahir Dar, school children

Introduction

Anemia is a condition in which the number and size of red blood cells, or the hemoglobin concentration of red blood cells (RBCs) falls below an established cutoff value, consequently impairing the capacity of the blood to transport oxygen around the body(Organization 2015, WHO 2015). The prevalence of anemia remains high and is an area of priority in low-income countries. According to 2011 WHO estimate, anemia affects around 800 million children and women. The highest prevalence of anemia was in children, 42.6%. Children in the African Region represented the highest proportion of individuals affected by anemia, 62.3% (Organization 2015)which causes the commonest and most intractable public health problems in Africa (Hughes et al., 2004)

According to the global estimates, by the year 2011 the prevalence of anemia among infants and children aged 6–59 months, in Ethiopia were 40-59.9% (Organization 2015). Similarly, different studies conducted on anemia in different parts of Ethiopia indicate that, the overall prevalence of anemia ranges 10.7% - 43.7%(Assefa et al., 2014, Desalegn et al., 2014, Gutema et al., 2014, Alelign et al., 2015).

Anemia varies by age, sex, altitude, smoking, and pregnancy status and causes major public health problem that affects low-, middle- and high-income countries. It also has significant adverse health consequences, especially in pregnant women and children, and adverse impacts on socio-economical development (Stevens et al., 2013).

Anemia is an indicator of both poor nutrition and health (WHO 2015). Iron deficiency anemia, which approximately account 50% of cases of anemia is thought to be the most common cause of anemia globally. Folate, vitamin B12 and vitamin A deficiency, chronic inflammation, parasitic infections, and inherited disorders can also cause anemia. Generally, anemia retards psychomotor development and impairs cognitive performance. In its severe form, anemia is associated with fatigue, weakness, dizziness and drowsiness (Organization 2015, WHO 2015) (Assefa et al. 2014, Desalegn, Mossie et al. 2014)

There are several factors associated with low level of anemia, including absence of pure water source, and latrine, illiteracy of mothers, large family size and parasite infections (Mesfin et al., 2015). For instance, Children having anemia as well as other parasitic infections are a number of times more likely to be stunted and underweight than those who do not (Hughes et al., 2004)

Failure to reduce anemia in school children will affect their school performance, increase school absence and decrease productivity. There is no regular surveillance system in Ethiopia to determine the magnitude of anemia among school children. There is also a lack of information on the determinant factors of anemia in the study area in particular and in Ethiopia at large. Therefore, the aim of the present study was to determine the burden and independent predictors of anemia among school children.

Materials and methods

Study design, period and area

A comparative cross-sectional study was conducted from March 2014 to May 2014 among elementary school children in Bahir Dar city and Mecha district, Amhara regional state, Northwest Ethiopia. Bahir Dar city is located 578 kilometers Northwest of Addis Ababa-the capital city of Ethiopia. The city contains 37 elementary schools with a total of 45,740 students. There are 10 governmental health centers, and one government hospital, one private hospital and more than 20 private clinics in Bahir Dar City. Mecha district is a rural area located 40 km North of Bahir Dar city with 40 kebeles. Mecha district has 101 elementary schools with a total of 80, 727 students. Mecha district also contains 10 governmental health centers and 26 health posts.

The study participants were school children selected from Bahir Dar and Mecha district elementary schools. All students who have not received anti-helminthic treatment in the last 6 months was included in the study. Students that have received anti-helminthic medication less than 6 months during a data collection time and unable to give stool and blood samples were excluded from the study. The sample size was calculated using Epi-info software version 7 assuming 95 % CI, 90 % power, 50 % anemia prevalence in rural children's, odds ratio of 1.5, design, effect of, 1.8, a rural to an urban ratio of 2 and a 15 % non-response rate. The final sample size was 2,509 students.

A multi stage sampling technique was used to select the schools in the Bahir Dar city and Mecha district. Ten elementary schools among 37 elementary schools in Bahir Dar city and 9 kebeles (one elementary school in each kebele was selected by simple random sampling) from 40 kebeles in Mecha district lottery method. The required participating children were selected using a simple random sampling technique in selected schools.

Data collection

Structured questionnaire was used to collect the socio-demographic data through face to face interview of students and parents or guardians. Twenty five diplomas and five degree holder nurses were participating for data collection and supervision, respectively.

Blood sample collection

Blood samples (1ml) were collected from each study participant for hemoglobin determination. Hemoglobin was determined using automated hematology analyzer. Hemoglobin level below 11 g/dl for children indicates anaemia (Crawley 2004).

Stool sample collection

Freshly passed stool specimens were collected using clean plastic cup in selected elementary schools. To detect diagnostic stages of helminths in Formol ether concentration technique (FECT), stool sample (0.5g) was transferred into 10 ml of normal saline in a glass container and mixed thoroughly. Two layers of gauze were placed in a funnel and strained the contents into 15 ml centrifuge tube. Then 2.5ml of 10% formaldehyde and 1ml of ether was added. The test tubes were mixed well and centrifuged at 1000 revolutions for three minutes. The sediment was mixed well, prepared to slide and covered with a cover slide and saw with.

Quality control

To ensure reliable data collection, training for data collectors, supervisors and laboratory technicians about the study was given before sample collection. Application of standard procedures and accuracy of test results was supervised by supervisors and principal investigator. Pretest was conducted with 50 parents, The collected data were checked for its completeness.

Data analysis

The data were entered using Epi-info software by 10 information technology (IT) technicians and analyzed using SPSS software version 20 and WHO Anpro-plus software. Descriptive statistics was used to identify the burden of anemia and magnitude of intestinal parasitosis. Binary logistic regression was used to identify the determinants of anemia. Multivariate logistic regression was used to check the confounding effects. The differences were considered to be statistically significant if p-value was < 0.05.

Ethics statement

Ethical clearance was granted from Amhara National Regional State Health Bureau (ANRSHB) ethical committee. Permission letters were obtained from the Amhara National, Regional State Education Bureau. Written informed consent was obtained from each study participant and parents or guardians of the children. The confidentiality of the data was kept at all steps. Students with intestinal parasites or low hemoglobin values were referred to the nearby health center for further management.

Results

Demographic characteristics

A total of 2,372 elementary school students was included; 1578 (66.5%) from rural and the remaining from urban settings giving for the response rate of 94.5%. Male students accounted 51% of the total study participants. The mean age of students was 12.7years with standard deviation of 2.9. (Table 1). The mean hemoglobin level was about 11.6 g/dl ranging from 10g/dl to 13 g/dl

Table 1: Socio-demographic profile of the study participants, Northwest Ethiopia, 2014

Population profile		Frequency	
		Urban	Rural
Age	5-9	125	259
	10-14	393	903
	15-19	276	416
Sex	Female	395	757
	Male	399	821
Grade	0-4	658	1291
	5-8	136	287
Educational status of the mother	Illiterate	86	1103
	Can read and write	113	384
	Elementary education	248	91
	Secondary education	206	0
	College or university	141	0
Source of water	Pipe	791	668
	Other	3	910
Income per month	< 1000 birr	426	348
	>=1000 birr	368	1230
Availability of latrine	Available	714	1091
	Not available	80	487
Work of parent	Farmer	1	1343
	Other	793	235

Hemoglobin determination

The overall prevalence of anemia among elementary school students was 7.6% (95 % CI: 7% - 9%). The prevalence of anemia among hookworm infected cases was 88 (16.6%). The prevalence of anemia among rural and urban children were 10.5 g/dl and 2 g/dl, respectively. The prevalence of anemia among ≤ 14 years old and > 15 years old children were 8.1% and 7.0%, respectively

Hookworm infection

The overall magnitude of hookworm infection among children was 530 (22.3%). The prevalence of hookworm among < 15 years old and ≥ 15 years old children were 27.7% and 14.9%, respectively. The prevalence of hookworm among anemic children was 88 (48.6%). The prevalence of hookworm among rural and urban children were 28.5 g/dl and 10.1 g/dl, respectively.

After adjusting for residence, hookworm infection, income, work of parent, availability of latrine, age, family size, sex, mother's education, and educational status: anemia was associated with residence, source of water, and the availability of latrine, maternal education, family size and hookworm infection (Table 2).

Table 2: Determinants of anemia among elementary school age children (n=2,372), Bahir Dar 2014.

Variable		Anemia		COR (95 % CI)	AOR (95 % CI)	P- value
		Yes	No			
Residence	Urban	16	778	0.18 (0.1-0.3)	0.26 (0.14-0.48)	<0.01
	Rural	165	1413			
Latrine	Available	96	1709	0.32 (0.23- 0.44)	0.65 (0.45 - 0.94)	0.02
	Not available	85	482			
Source of water	Pipe	66	1393	0.33 (0.24 - 0.46)	0.55 (0.39 - 0.78)	<0.01
	Other	115	798			
Mother's educational status	Literate	78	1105	0.74 (0.54-1.02)	0.63 (0.45 – 0.94)	<0.01
	Illiterate	103	1086			
Family size	>4	38	562	0.77 (0.52-1.13)	1.49 (1.02 – 2.19)	0.04
	≤ 4	143	1629			
Hook worm infection	Yes	88	442	3.74 (2.72 - 5.16)	2.53 (1.74 - 3.68)	<0.01
	No	93	1749			

Discussion

Childhood anemia is considered a severe public health problem in most countries of sub-Saharan Africa. In this region, parasitic diseases and low bioavailable iron intake are major causes of anemia (Magalhaes and Clements 2011, Glinz et al., 2015). Nutritional deficiency, economic constraints of the country and high burden of intestinal parasitic infections may lead to high prevalence of anemia (WHO 2015). In the present study prevalence of anemia was 7.6%, which was low when compared to previous studies conducted in different parts of Ethiopia (Desalegn et al., 2014, Gebreegziabiher et al., 2014, Gutema et al., 2014, Alelign et al., 2015) and Upper Egypt (Salama and Labib 2016) but higher than a study done United States of America (Syed et al., 2014). The possible justification for the difference in prevalence of anemia might be a large sample size, geographical difference, family economic status, civilization and behavioral variations of factors across these different settings. On top of this, currently in Ethiopia there are a number of interventions made by the ministry of health through health extension workers that might contribute its share for decrement of the burden of anemia among school children.

From multivariable logistic regression analysis, a significant association was obtained between anemia and residence; source of water; availability of latrine; maternal education; family size and hookworm infections. Living in urban settings, using pipe water, using latrines, mothers being literate and living in a family size of less than four were protective for anemia. It is the fact that those children living in relative with better socioeconomic status and environment are more likely to have good nutritional support and better health condition as compared with their counterparts. Similar findings were reported by different studies conducted in Ethiopia (Desalegn, Mossie et al. 2014, Gebreegziabiher et al., 2014, Gutema et al., 2014).

Although immense development in socioeconomic status has occurred in recent years, intestinal parasitic infections like hookworm are still a common public health problem in school children in many parts of the world, particularly in developing countries (Shang et al., 2010). On the other hand, children with hookworm infections were found

significantly more anemic (Gebreegziabiher, Etana et al. 2014) than those children who do not infected by the parasites (AOR=2.53 (95% CI: 1.74 - 3.68) in the present study. Similar findings were obtained from Southeast Ethiopia (Gutema et al., 2014), Northwest Ethiopia (Alelign et al., 2015), Tanzania (Tatala, Kihamia et al. 2009) and Nigeria (Osazuwa and Ayo 2010). This showed that hookworm might be one basic determinant factor for the high prevalence of anemia in developing countries.

The major strength of the study was large sample size or representativeness. The limitation of this study was unable to measure the serum iron level, vitamin B₁₂ and folate levels, which could help to identify specific causes of anemia in the children.

Conclusion

In the current study, anemia still remains as a public health problem among the school-age children in the study area. Determinant factors like living in urban settings, absence of latrine and pipe water, illiterate mothers and hookworm infection contribute the high prevalence of anemia. Therefore, emphasis should be given to reduce the risk of anemia through health education providing diet containing adequate amounts of bioavailable iron and deworming.

Competing interests

We authors declare that we have no competing interests.

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Author contributions

Conceived and designed the study: BEF, FB and AD. Performed the experiments: DM YZ TH FB YA BT. Analyzed the data: BEF. Draft the manuscript: AD TH and BEF.

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