ORIGINAL ARTICLE

Anemia among School-Age Children: Magnitude, Severity and Associated Factors in Pawe Town, Benishangul-Gumuz Region, Northwest Ethiopia

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ABSTRACT

BACKGROUND: *Anemia is a global public health problem associated with increased mortality and morbidity. The cause of anemia in school-age children is multifactorial and has been associated with delayed psychomotor development, poor cognitive performance, impaired immunity and decrease working capacity. The aim of this study was to determine the magnitude, severity and determinant factors of anemia among school-age children (5-15 years) in Pawe Town, Northwest Ethiopia.*

METHODS: *A community based cross-sectional study was conducted from March 20 to June 19, 2015 in Pawe Town. A total of 422 school-age children were included in this study. Socio-demographic and related data were collected using structured questionnaire. Anthropometric data were collected from each study participant. Hemoglobin concentration was measured using HemoCue® Hb 201+ System (HemoCue, Angelholm, Sweden). Blood film for malaria diagnoses and stool examination for intestinal parasites were also performed. Data were analyzed using SPSS version 20.0.*

RESULTS: *The overall prevalence of anemia among school-age children was 33.9%. Mothers' illiteracy (AOR=7.5, 95% CI: 2.6-16.3), being from a family with low income (AOR=4.8, 95% CI: 1.3-10.9), being stunted (AOR=7.1, 95% CI: 2.9-11.9), being underweight (AOR=5.3, 95% CI: 2.1-13.3), infection with intestinal parasites (AOR=5.2, 95% CI: 2.1-12.6), and malaria infection (AOR=8.2, 95% CI: 1.8-14.5) were identified as associated factors of anemia.*

CONCLUSION: *In this study, anemia is a moderate public health problem among school-age children. School health strategies and interventions targeting nutritional deficiencies and parasitic infections might be very important.*

KEYWORDS: *Anemia, Associated factors, School-age children, Pawe Town, Ethiopia*

INTRODUCTION

Anemia is a condition where there is a reduction of hemoglobin (Hb) level in the blood, resulting in lower quantity of oxygen transported via blood for physiological need (1). Anemia is a global public health problem and affects 24.8% of the world population (2). Anemia is a major public health problem among women and children; school-age children are one of the groups for whom it is common (3). Anemia also continues to be a major public health problem in Ethiopia. The Ethiopian Demographic and Health Survey (EDHS) key indicator at different times reported the prevalence of anemia among children from 44-56% (4-6). There are different root causes of anemia which include increased red blood cell (RBC) destruction due to malaria, blood loss due to helminthiasis and hemorrhage, reduced RBC production due to nutritional deficiencies of iron, vitamin B_{12} and chronic infections. Although anemia has a variety of causes, it is generally assumed that 50% of its causes is iron deficiency (7-12).

Anemia has a negative impact in the physical, mental and cognitive development of children. Besides, it has economic impact by increasing impairment of lives and disability, reduction in intellectual capacity and loss of productivity due to increased morbidity from infectious diseases (13,14). In Ethiopia, most studies on anemia and micronutrient interventions were focused on pregnant women and pre-school children. Even though few local studies showed anemia prevalence, national representative data are not available on school-age children particularly in our study area. To mitigate the impacts of anemia, there is a need to emphasis this segment of the population using schools as a practical platform to deliver an integrated package of interventions. To do so, evidence based development of possible strategies and intervention for the problem will have eminent contribution, which needs an effective surveillance and monitoring. Without these steps, we cannot go anywhere. Therefore, the aim of this study was to determine the magnitude, severity and associated factors of anemia among school-age children in Pawe Town, Benshangul-Gumuz Region.

MATERIALS AND METHODS

Study design and setting: A community based prospective cross sectional study was conducted in Pawe Town, Metekel Zone, Benishnagul-Gumuz Region, Northwest Ethiopia, from March 20 to June 19, 2015. The town is located 557Km away from Addis Ababa at $11^0$19'59.47"N latitude and $36^0$25'00.66'' E longitude with an average altitude of 1050-1250 meters above sea level. The estimated population of Pawe Town was 3,522 and 880 households, an average of 4 persons per household. The area has been highly endemic for malaria (15).

The sample size was estimated using single population proportion formula by the following assumptions: 95%, 5% and 50% level of confidence, margin of error and proportion (P), respectively. Households were selected using systematic sampling technique from all the three Kebeles (smallest administrative units) in the town (Figure 1). A total of 422 school-age children, between 5-15 years, living in Pawe Town were included in the study. On the other hand, children on treatment of anemia were excluded from the study.

Data collection techniques and instruments: Interviewer based structured questionnaire was used to collect socio-demographic and related data. Height and weight were measured according to standard anthropometric methods (16). Height was measured to the nearest 0.1 centimeters in bare feet standing upright against the Seca height measuring tape. Weight was measured to the nearest 0.1 kilogram using a digital scale. During weight measurement, study participants wore underwear and T-shirt only. Weight and height were measured twice and the mean value was used for the analysis.

Capillary blood was collected from each participant for Hb and peripheral blood preparation. HemoCue® Hb 201^+ System (HemoCue, Angelholm, Sweden) was used to

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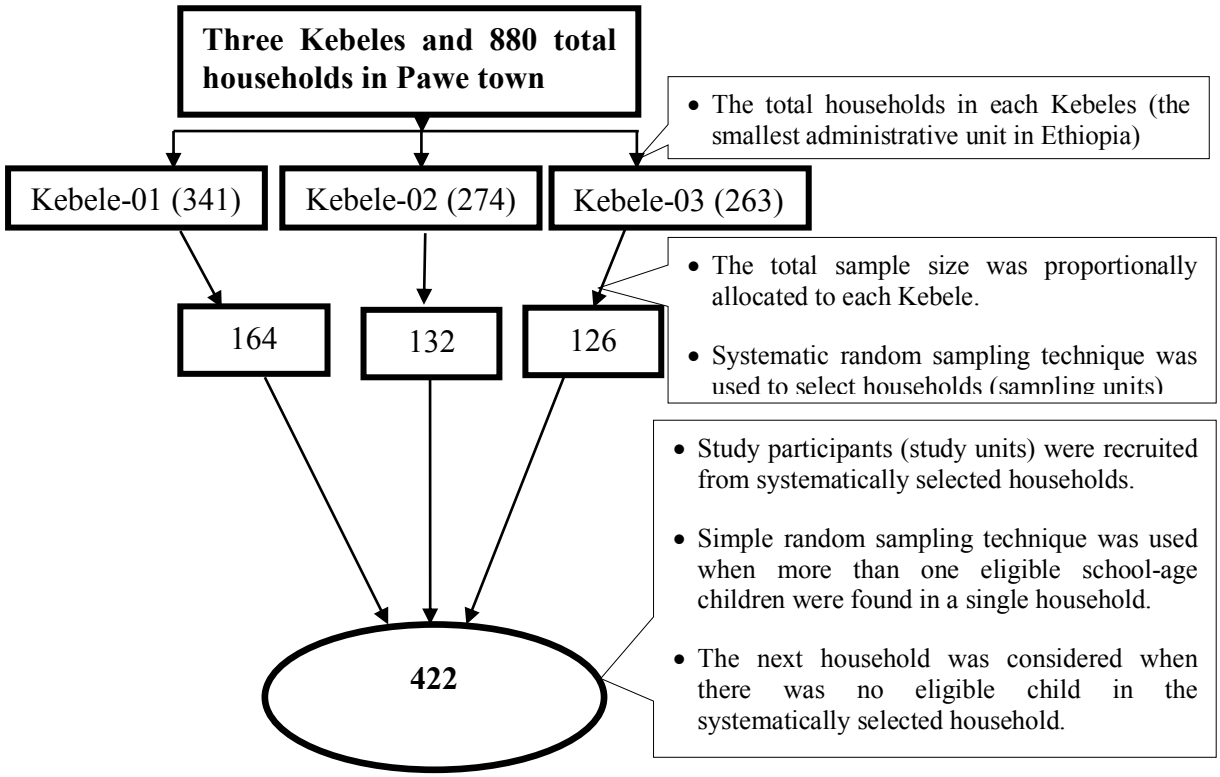

Figure 1: *Sampling technique among school-age children living in Pawe Town, Northwest Ethiopia, 2015.*

determine Hb concentration. Free flowing capillary blood was allowed to enter the microcuvette. The cuvette was placed into the cuvette holder for photometric quantitative readout of Hb concentration in g/dL. Both thick and thin blood films were prepared from each study participants and stained with Giemsa stain. Blood films were examined for hemoparasites. Stool sample was collected from each study participant using leak-proof and clean stool cup. Stool samples were examined for intestinal parasitic infection using both direct wet mount and formol-ether concentration techniques.

To assure the quality of data, training was given for data collectors. Supervision was made daily during the data collection period. All the laboratory activities were performed following standard operating procedures and manufacturers' instruction. Expiry dates of all laboratory reagents were checked.

Data analysis and interpretation: Z-scores for each study participant were calculated using World Health Organization (WHO) anthroPlus1.0.4 statistical software for age between 5–15 years. Children who had less than −2 Z-scores (−2SD) values were considered under nutrition (17). Hb concentration was adjusted for altitude (18). Anemia was defined based on WHO Hb concentration cut-off value after adjusted for altitude (1). Study participants with Hb concentration < 11.5g/dL and 12g/dL were considered as anemic for 6-11 and 12-15 years old children, respectively. Mild anemia was defined as Hb concentration between 10 g/dL and 12 g/dL in males and between 10 g/dL and 11.5 g/dL in females. Moderate and severe anemia were defined when Hb concentration was between 7 g/dL and 9.9 g/dL and < 7 g/dL, respectively. All the data were initially entered and cleaned using Epi-data version 3.1 and then exported to SPSS version 20.0 for analysis. Descriptive statistics was done to indicate the frequency of the variables. Multivariable logistic regression analysis was used to identify the associated factors

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of anemia. All variables with P value < 0.05 were considered as statistically significant.

Ethical consideration: Ethical approval was obtained from Assosa University Ethical Review Board. Official permission was obtained from Pawe Woreda Health Bureau to conduct the study. Informed written consent was taken from the parents/guardians. Moreover, assent was obtained from each child greater than 7 years old. The data collected from the participants will remain anonymous for indefinite period of time. All the study participants who were found positive for intestinal parasites, had malaria and were anemic were treated free of charge at Pawe General Hospital, Northwest Ethiopia.

RESULT

Socio-demographic characteristics of the study participants: Four hundred and twenty-two study participants were participated in this study of whom 54.0% (n=228) were female. The majority of the study participants, 87.9% (n=371), were in the age group of 5-11 years. The mean age of the study participants was 8.32 ± 2.42 years. Most of the children's mothers, 69.9%, (n=295) and 82.9% (n=350), were illiterate and housewives, respectively (Table 1).

Table 1: Socio-demographic characteristics of school-age children living in Pawe Town, Northwest Ethiopia, 2015 (n=422)

Variables	Categories	Frequency	Percentage
Age (years)	5-11	371	87.9
	12-15	51	12.1
Sex	Male	194	46.0
	Female	228	54.0
Mother's occupation	House wife	350	82.9
	Merchant	25	5.9
	Daily labor	10	2.4
	Employed	37	8.8
Father's occupation	Farmer	71	16.8
	Merchant	131	31.0
	Daily labor	134	31.8
	No job	54	12.8
	Employed	32	7.6
Mother's education	Illiterate	295	69.9
	Literate	127	30.1
Father's education	Illiterate	195	46.2
	Literate	227	53.8
Monthly household income (ETB)	<500	173	41.0
	500-1999	190	45.0
	≥2000	59	14.0
Family size	≤5	148	35.1
	>5	274	64.9

ETB: Ethiopian Birr

Nutritional and clinical characteristics of the study participants: Among the total study participants, 34.4% (n=145) were stunted for their age while 32.2% (n=136) were underweight. Regarding intestinal parasites, 30.8% (n=130) of the children had intestinal parasites from whom, *Hymenolepis nana,* 45.4% (n=59), took the highest proportion followed by Hookworm, 26.9% (n=35). Twenty-nine (6.9%) of the study participants were infected with *P. falciparum* malaria (Table 2).

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Table 2: Nutritional and clinical characteristics of school-age children living in Pawe Town, Northwest Ethiopia, 2015 (n=422)

Variables		Frequency	Percentage
Stunting (Z-score < -2SD)		145	34.4
Underweight (Z-score < -2SD)		136	32.2
Intestinal parasites infection		130	30.8
Type of intestinal parasite (n=130)	*H. nana*	59	45.4
	Hookworm	35	26.9
	G. lamblia	20	15.4
	S. mansoni	3	2.3
	H. nana and G. lamblia	8	6.2
	H. nana and Hookworm	5	3.8
P. falciparum		29	6.9

SD: Standard devation; H. nana: Hymenolepis nana; G. lamblia: Giardia lamblia; S. mansoni: Schistosoma mansoni; P. falciparum: Plasmodium falciparum

Prevalence and associated factors of anemia: The mean Hb value of school-age children was 12.06 ± 1.20 g/dL. The overall prevalence of anemia was 33.9% (n=143), from whom, 86.7% (n=124) and 13.3% (n=19) had mild and moderate anemia, respectively. After adjusting for all the measured explanatory variables in the multivariable regression model, mother education (AOR = 7.5, 95% CI: 2.6-16.3)**,** being from a family with low income (AOR = 4.8, 95% CI: 1.3-10.9), being stunted (AOR = 7.1, 95% CI: 2.9-11.9), being underweight (AOR = 5.3, 95% CI: 2.1-13.3), having intestinal parasite infection (AOR = 5.2, 95% CI: 2.1-12.6) and being infected by *P. falciparum* malaria (AOR = 8.2, 95% CI: 1.8-14.5) were significantly associated with anemia (Table 3).

DISCUSSION

The aim of this study was to determine the prevalence of anemia and associated factors among school-age children living in Pawe Town, Northwest Ethiopia. Accordingly, more than one third of school-age children had anemia. Anemia was a moderate public health problem in the study area.

The prevalence of anemia in our study was higher compared with similar studies done in Denizli Turkey (19), Vietnam (20), Qinghai and Ningxia elementary schools in China (21), Serbia (22), Cape Verde (23), Kenitra Morroco (24), Kersa Eastern Ethiopia (25), Filtu Town Somali Southeast Ethiopia (26), Durbete, Northwest Ethiopia (27) and Addis Ababa (28). The high prevalence of anemia in this study might be attributed to the high prevalence of intestinal parasites and malaria as compared with other studies. This indicates that there is a need to give an attention on this segment of the population using schools as a practical platform to deliver an integrated package of interventions to mitigate the magnitude and/or impacts of anemia in our study area.

The prevalence of anemia was significantly associated with certain socio-demographic characteristics of children and their families. Children from families with low monthly household income were more likely to be anemic compared with children from families with high monthly household income. This might be due to the fact that families with low monthly household income might not get enough iron-rich foods, and diets of children living in poor families are usually monotonous. Low income in the family thus limits the type and amount of food availablity. The finding corroborated the reports of similar studies conducted in Ningxia and Qinghai's poor counties of rural China (21), India (29, 30) and Edo State of Nigeria (31). Children who had illiterate mothers were more likely to be anemic compared to children whose mothers were literate.

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Table 3: Factors associated with anemia among school-age children in Pawe Town, Metekel Zone, North-West Ethiopia, 2015.

Variables	Categories	Anemia		COR (95%CI)	AOR (95% CI)
		Yes N(%)	No N(%)		
Age (years)	5-11	131 (35.3)	240 (64.7)	1.8 (0.9-3.5)	3 (0.95-9.4)
	12-15	12 (23.5)	39 (76.5)	Ref (1)	Ref (1)
Sex	Male	72 (37.1)	122 (62.9)	1.3 (0.87-1.96)	1.15 (0.55-2.4)
	Female	71 (31.1)	157 (68.9)	Ref (1)	Ref (1)
Mother's occupation	House wife	130 (37.1)	220 (62.9)	4.9 (1.7-14.1)†	3.6 (0.8-16.1)
	Merchant	5 (20.0)	20 (80.0)	2.1 (0.5-8.6)	4.7 (0.5-41.6)
	Daily labor	4 (40.0)	6 (60.0)	5.5 (1.1-14.6)*	1.5 (0.02-11.3)
	Employed	4 (10.8)	33 (89.2)	Ref (1)	Ref (1)
Father's occupation	Farmer	27 (38.0)	44 (62.0)	2.7 (0.97-7.3)	1.1 (0.2-6)
	Merchant	32 (24.4)	99 (75.6)	1.4 (0.5-3.7)	2.1 (0.4-10.9)
	Daily labor	54 (40.3)	80 (59.7)	2.9 (1.1-7.6)*	1.4 (0.3-7.3)
	No job	24 (44.4)	30 (55.6)	3.5 (1.2-9.8)*	1.7 (0.3-11.2)
	Employed	6 (18.8)	26 (81.2)	Ref (1)	Ref (1)
Mother's education	Illiterate	126 (42.7)	169 (57.3)	4.8 (2.7-8.5)‡	7.5 (2.6-16.3)‡
	Literate	17 (13.4)	110 (86.6)	Ref (1)	Ref (1)
Father's education	Illiterate	77 (39.5)	118 (60.5)	1.6 (1.1-2.4)*	1.5 (0.7-3.5)
	Literate	66 (29.1)	161 (70.9)	Ref (1)	Ref (1)
Monthly household income (ETB)	<500	100 (57.8)	73 (42.2)	8.7 (3.9-14.6)‡	4.8 (1.3-10.9)*
	500-1999	35 (18.4)	155 (81.6)	1.44 (0.6-3.3)	1.4 (0.4-5.1)
	≥2000	8 (13.6)	51 (86.4)	Ref (1)	Ref (1)
Family size	≤5	44 (29.7)	104 (70.3)	Ref (1)	Ref (1)
	>5	99 (36.1)	175 (63.9)	1.3 (0.9-2.1)	1.73 (0.8-3.9)
Intestinal parasite infection	Yes	89 (68.5)	41 (31.5)	9.5 (6-15.4)‡	5.2 (2.1-12.6)‡
	No	54 (18.5)	238 (81.5)	Ref (1)	Ref (1)
P. falciparum malaria	Yes	22 (75.9)	7 (24.1)	7 (2.9-16.9)‡	8.2 (1.8-14.5)‡
	No	121 (30.8)	272 (69.2)	Ref (1)	Ref (1)
Stunting (Z-score <-2SD)	Yes	109 (75.2)	36 (24.8)	5.7 (2.8-14.7)‡	7.1 (2.9-11.9)‡
	No	34 (12.3)	243 (87.7)	Ref (1)	Ref (1)
Underweight (Z-score < -2SD)	Yes	102 (75.0)	34 (25.0)	7.9 (3.7-18.2)‡	5.3 (2.1-13.3)‡
	No	41 (14.3)	245 (85.7)	Ref (1)	Ref (1)

*AOR: Adjusted Odd Ratio; CI: Confidence Interval; ETB: Ethiopian Birr; SD: Standard deviation; P. falciparum: Plasmodium falciparum; Ref: Reference; *: significant association at P<0.05; †: significant association at P<0.01; ‡: significant association at P<0.001*

A similar study conducted in Kenitra Morroco (24) also showed that anemia was significantly associated with mother education. Low level of mothers' education may affect children's nutritional status negatively. This might be related to lack of knowledge and awareness on the use of diversified diets including iron and other micronutrients.

The prevalence of anemia also changed according to the nutritional status of the children. Stunted children were 7 times more likely to be anemic than non-stunted children, and underweight children were 5 times more likely to be anemic compared to children having normal weight. Our finding was in agreement with studies done in Punjab India (29), Tanzania (32), Kenya (33,34) and Nigeria (35) which showed that anemia was significantly associated with malnutrition. This might be due to the fact that a diet containing low amount of bioavailable iron or

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inadequate dietary iron intake and other micronutrient deficiency is one of the main causes of anemia particularly in children (7,9,10).

In this study, the prevalence of anemia was significantly high in school-age children who had intestinal parasitic infection. This might be due to the fact that most intestinal parasites particularly hookworm have their own contribution to blood loss and/or red cell destruction and thus contribute to anemia. However, we did not assess the association of each parasite to anemia due to our sample size. Our finding was supported by studies reported from Tanzania (32) and Edo state Nigeria (31).

The prevalence of anemia was also significantly associated with malaria. Children infected with *P. falciparum* malaria were more likely to be anemic compared to none infected children. This finding is supported by the study done in Nigeria (35) which showed that anemia was significantly associated with malaria. The possible explanation for this could be that malaria is one of the major causes of anemia by causing increased destruction of both parasitized and un-parasitized erythrocytes (immune-mediated hemolysis, phagocytosis, splenic sequestration) and by decreasing production of RBCs in the bone marrow (bone marrow suppression, inadequate reticulocyte production, effects of inflammatory cytokines and effects of parasite factors) (36).

The findings of this study should be interpreted in light of the following limitations. Since the study was cross-sectional in design, it was impossible to determine cause-effect relationships. Moreover, micronutrient among study participants was not assessed to identify the root causes of anemia.

In conclusion, more than one third of school-age children were anemic. Anemia in this study was a moderate public health problem among school-age children. Mother's illiteracy**,** being from a family with low income, being stunted, being underweight, having intestinal parasite infection and being infected by *P. falciparum* malaria were identified as independent predictors of anemia. Multi-sectoral and integrated packages of interventions on identified determinant factors of anemia using schools as a platform for this segment of population will have imminent contribution to combat the problem.

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