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Assessment of the Prevalence of Anaemia and Associated Risk Factors among Children Under Five Years in rural communities of the Hohoe Municipality, Ghana.

Margaret Kweku[1], Phyllis Atta Parbey[1],Wisdom Takramah[1], Richard Owusu[1], Wisdom KudzoAxame[1], Martin Adjuik[1], Elvis Tarkang[2,*].

[1]Department of Epidemiology and Biostatistics, School of Public Health, University of Health and Allied Sciences, Ho, Volta Region, Ghana; [2]Department of Population and Behavioural Sciences, School of Public Health, University of Health and Allied Sciences, Ho, Volta Region.

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Abstract: Background: Anemia in children continues to be a major public health challenge in most developing countries. This study determined the prevalence of anaemia and its associated risk factors among children under five in four rural communities in the Hohoe Municipality. ***Methods:*** A descriptive community-based cross-sectional study was carried in November 2015. Interviews with semi-structured questionnaires were used to obtain information from mothers of children on socio-demographic characteristics, dietary and feeding practices of the children. Axillary temperature and anthropometric indices were measured using standard methods. Finger-prick blood samples were collected for Haemoglobin concentration measurement and blood film for malaria parasites. Chi-squared test and logistic regression were used to determine theassociation between dependent and independent variables. ***Results:*** Of the 235 children surveyed, 113 (48.1%) were anaemic (Hb<11.0g/dl) and17 (7.2%) had low Haemoglobin (Hb< 8.0g/dl). Malaria prevalence by microscopy was 40 (17.0%)andlong-lastinginsecticide-treatednet (LLIN) usage was 173 (73.6%). Anaemia was significantly higher among children aged 6-23 months than those aged 24-59 months (χ^2 =4.91, p=0.027).Children of mothers aged between 40-49 years were 84% times less likely to have anaemia as compared to those aged less than 30 years (AOR=0.16, p=0.005). Children who tested negative for malaria were 75% times less likely to have anaemia (AOR=0.25, p<0.001).No significant difference was observed between males and females, LLIN usage and consumption of iron, vitamin B12, folate and anaemia. ***Conclusion:*** Anaemia prevalence in the rural Hohoe Municipality is relatively low compared the 74% reported bythe Ghana Demographic Health Survey in 2014 for rural Ghana. Age of mother and malaria parasitaemia were factors found to be contributing significantly to anaemia. Future interventions should include promotion of foods containing iron, Vitamin B12 and folate, continuous use of LLIN and intermittent preventive treatment of asymptomatic malaria.

Keywords: Rural community, Anaemia, Malaria parasitaemia, Risk factors, Children under five years, Hohoe Municipality, Ghana.

INTRODUCTION

Anaemia is one of the most serious public health problems affecting people in both developing and industrialised countries. It is defined as a decrease in the concentration of circulating red blood cells or in the Haemoglobin (Hb) concentration and a concomitant impaired capacity to transport oxygen[1].The global estimate of anaemia in children indicates thatapproximately293.1 million children under five years (43%) are anaemic worldwide and 28.5% of these children are residing in sub-Saharan Africa (SSA). In the developing countries, it is reported that an estimated 3.5 billion people are anaemic [1,2]. The 2008 World Health Organization (WHO) estimate of anaemia prevalence in Africa was 64.6% as compared to the prevalence in Europe (16.4%) and in North America (3.4%). The most prevalent nutritional disorder is iron deficiency anaemia, with Africa being the most affected region [3]

Anaemia can occur at any time and at all stages of the life cycle, with pregnant women and preschool-age children at the greatest risk, making them vulnerable[1]. The prevalence of mild and moderate anaemia may attribute to mortality risk[4]. Anaemia in children is of particular interest since it impairs their mental, physical and social development, causes low immunity, negative behavioural and cognitive effects resulting in poor school performance and work capacity in later life, thereby reducing earning potential and damaging national economic growth in the future [2,5].

Several factors contribute to childhood anaemia, but their relationships to the onset of anaemia are not identical. The aetiology of anaemia is multifactorial. Studies have shown that low iron diet intake and malaria are commonly known to be associated with anaemia [5].Other factors associated with anaemia are parasitic infections (hookworm and tapeworm), acute or chronic inflammations, inherited or acquired disorders that affect Haemoglobin synthesis, red blood cell production or red blood cell survival and nutritional deficiencies [6].Socio-economic factors may also affect the risk of anaemia by affecting the nutritional status, family size and birth interval, as well as intensifying problems of affordability and accessibility of preventive and curative measures [7].In the developing countries, insufficient dietary iron is considered the primary cause of anaemia in children. However, factors such as early weaning, poor health of pregnant women, unsafe drinking water, inadequate hygiene and sanitary conditions, and poverty may contribute to the development of anaemia [3].

Studies conducted on the prevalence and possible risk factors of anaemia in children under five in rural communities have shown that, in Northeastern Brazil, the prevalence of anaemia was 31.5% in urban areas and 36.6%

in the rural areas. Maternal and the child's age were significantly associated with anaemia in the rural areas [8]. Another study conducted in Cuba showed that the prevalence of anaemia in children under five years was higher in rural than in urban areas (28.5% vs. 23.5%, p=0.012)[9]. Another cross-sectional study done in a rural setting in Western Uganda revealed that the prevalence of anaemia was 26.2%. The place of birth, the age of the child, complementary foods, formal education and nutrition knowledge of the mother were factors that were significantly associated with anaemia among the children [10].

Due to the increasing burden of anaemia, currently in Ghana, efforts have largely been directed towards increasing iron supplements intake among pregnant women, anti-malaria medication for pregnant women, recommended feeding practices for children under five (exclusive breastfeeding and complementary feeding practices) as well as the use of insecticides treated mosquito nets for both mother and child. Despite the above-stated efforts, there is still a high prevalence of anaemia in children under five years.

In 2014, the Ghana Demographic and Health Survey(GDHS)[11] reported anaemia prevalence to be 66% among children under five and for Volta region a prevalence of 69.6%. However, anaemia prevalence among children has decreased from 78 percent in 2008 to 66 percent in 2014. Inthe GDHS 2014 [11], the prevalence was higher in rural than urban areas (74% vs. 57%).The School of Public Health (SPH) of the University of Health and Allied Sciences (UHAS) has selected four rural communities in the Likpe sub-Municipality within the Hohoe Municipality asafield site for disease surveillance activities and therefore has to carry out baseline surveys. With the high level of anaemia and unknown risk factors of anaemia among children under five years in the rural communities, we assessed the prevalence and associated risk factors of anaemia among children under five years in these selected communities as part of baseline activities for future interventions

METHODS

Study site:

The current study was conducted in the Hohoe Municipality which is one of the twenty-five administrative districts of the Volta Region. The Municipality is located in the central part of the region with a total land surface area of 1,172 km square. The Municipality consists of 102 communities with a total population of 167,016 people [12]. It is located at longitude 0º 15 East and 0º45 East and latitude 6º45º North and 7º 15º North and lies almost in the heart of the Volta Region. It is bounded by Jasikan District to the North, Northwest by Biakoye District, South by Afadjato South District, West and South West by Kpando Municipality and East by the Republic of Togo. There are two main seasons, the wet and dry seasons. The major wet season lasts from April to July and the minor one from September to November. The rest of the year is relatively dry. The average recorded annual rainfall in the Municipality by the Hohoe Municipal MeteorologicalDepartment (HMMD) is 1,592 mm with approximately 1,296 mm rain falling between April and October[13]The Municipality has been divided into seven (7) Health Sub-Municipalities namely: Akpafu/Santrokofi, Alavanyo, Agumatsa, Lolobi, Gbi-Rural, Hohoe-Sub and Likpe. Hohoe Municipality has a total of Twenty-one (21) health facilities including Municipal Hospital (1), Health centres (14) and Community-based Health Planning and Services (CHPS) compounds (6). There are 57 Expanded Programme on Immunisation (EPI) outreach clinics which operate monthly.

Study Design:

The design was a cross-sectional study carried out in November 2015 (the end of the high transmission season). Data were collected in the form of interviews and collection of biological samples.

Study population:

The population for the study was all children in the selected communities aged 6 to 59 months who were eligible and their parents/guardians consented to participate.

Sampling and sample size determination:

A purposive sampling technique was used to select four communities in this study. The sample size was estimated on the basis of the following: 95% confidence level (Z) and power of 80%, the prevalence of anaemia in children under five in the rural areas (p) of 43.7% [11]. The least acceptable prevalence of malaria was 5.0%. Using Open Epi software version 3 [14], the sample size calculated for each of the cross-sectional surveys was 218 children aged less than 5 years (Fleiss Statistical Methods with Continuity Correction). However, all children whose parents/guardians reported for the survey, consented and were willing to participate, were included. Therefore, a total 235 were included in the survey.

Data Collection:

Data collection involved asking parents/guardians of the children questions and collecting finger-prick blood from the children for laboratory investigations. During the survey, all eligible children were gathered at an agreed common meeting place and temperature, weight, height and mid-upper-arm circumference were measured. Information was obtained from parents/guardians on demographic characteristics, socioeconomic status, child feeding practices, dietary diversity and LLIN ownership and use. Finger prick blood sample was collected for determination of malaria parasitaemia and Haemoglobin (Hb) concentration level.

LABORATORY METHODS

Rapid Diagnostic Testing of Malaria in Human Blood:

Care Start^{TM} Malaria HRP2 test kit (Access Bio Inc, New Jersey, USA) was used for the rapid qualitative detection of Malaria Histidine-rich Protein 2 (HRP2) in human blood as an aid in the diagnosis of malaria infection. Using this kit, 5 µL of whole blood was introduced into the sample well with the aid of a pipette after finger pricking. Three drops of assay buffer were added to the buffer well. The result was read within 20 minutes.

Malaria blood films for microscopy:

Thick blood films were prepared on a glass slide using 10 µL of blood, evenly spread to cover an area of 15 x 15mm of the slide. The smear was stained with 10% Giemsa for 10 minutes and then examined under oil immersion with a light microscope (magnification x 100). The slides were double read by trained Microscopists. Asexual parasite densities were estimated by counting the number of parasites per 200 white blood cells (WBCs) in the thick film. Parasite counts were converted to parasites per microliter (µl), using relative WBC of 8000 leukocytes per µl of blood [15]. A sample was considered negative if no parasite was counted after 200 high power fields had been read. If there occurred discrepancies in the findings in a slide between the two initial technicians (positive or negative or a 50% or more difference in parasite density) a third, more senior Microscopist reading was deemed necessary and then adopted. Two senior Microscopists from the Noguchi Memorial Institute of Medical Research (NMIMR) and University of Health and Allied Science (UHAS), examined all the positive blood films including a 20% random sample of negative blood slides for quality control.

Haemoglobin and fever measurement:

Haemoglobin was measured using URIT-12 Haemoglobin Meter (URIT Medical Electronic Co., Ltd. UK) whilst fever was measured using ananelectronic thermometer (MODE: ZC, SURGILAC Digital Thermometer, UK).

Anthropometric Measurement:

Children under one year were weighed naked while older children above one year were weighed with their pants on Seca weighing scales (Hamburg, Germany) to the nearest 10 grammes. The length of children aged less than 24 months were measured using a non-stretchable tape to the nearest mm and a locally made measuring board precise to 1 mm. Children aged 24 months or more had their height measured while standing using a locally made measuring board precise to 1 mm. Mid-Upper Arm Circumference (MUAC) was measured on the left arm to the nearest 1 mm using a non-stretchable tape.

Definitions:

Fever: defined as axillary temperature ≥ 37.5%ºC.
Normal Haemoglobin level: defined as Hb≥11.0gm/dl.
Anaemia: defined as Hb<11.0g/dl.
Low Haemoglobin (low Hb): defined as an Hb<8.0 g/dl.

Data Analysis:

Data were entered using Epi Data 3.1 software and then exported to STATA 14.1(STATA Corporation, Texas, USA) for analysis. After data was entered, cleaning and validation were done to ensure data quality before analysis was carried out. Descriptive statistics such as proportions and frequency distribution were performed to describe categorical variables. Inferential statistics such as Chi-square test and logistic regression were used to assess the associations between the categorical dependent and independent variables. Haemoglobin was adjusted for age of child, age of mother, malaria parasitaemia by microscopy, parity, food content and LLIN. P-value <0.05 was considered as statistically significant.

Ethical Issues:

The study was approved by the Ethical Review Committee (ERC) of the Ministry of Health/Ghana Health Service (MOH /GHS) with approval number, ID NO: GHS-ERC: 14/05/15. Before the commencement of the study, permission was sought from the Hohoe Municipal Health Directorate (HMHD). Permission was also sought from the chiefs and elders in the selected communities. A written informed consent was obtained from the parents/guardians of the children. All the information collected was treated confidentially and used for research purposes only.

RESULTS

Background characteristics of children and their parents/guardians:

Table 1 shows that a total of 235 children aged 6 to 59 months with mean age 30.11±17.11 months, were recruited for the study. Of the 235 children, 114 (48.5%) were males. Most of the children 198 (84.3) ownedan LLIN and 173 (73.6%)of them slept inside an LLIN the night before the survey. Stunting was 44 (18.7%), wasting was 40 (17.0%) and underweight was 43 (18.3%) among the children.

The mean age of parents/guardians of the children was 30.1±17.1 years.The majority (63.4%) of the parents/guardians were married. Most parents/guardians, (94.9%) were Christians. Only 19.6% of the parents/guardians had a parity of one child. More than half of the parents/guardians (65.5%) had Primary/Junior High School (JHS) Education. Most parents/guardians were farmers (34.9%). About 198 (84.3%) owned LLIN and 173 (73.6%) slept inside an LLINthe night before the survey.

Table 1. Background characteristics of children and their parent/guardians (N=235)

Characteristics	**Frequency n (%)**
Mean age (SD)	30.11(17.11)
Age(Months)	
6- 11	38 (16.2)
12-23	59 (25.1)
24-35	32 (13.6)
36-47	45 (19.2)
48-59	61(26.0)
6-23	97 (41.3)
24-59	138 (58.7)
Gender	
Male	114 (48.5)
Female	121 (51.5)
Own LLIN	
No	37 (15.7)

Yes	198 (84.3)
LLIN usage	
No	62 (26.4)
Yes	173 (73.6)
HAZ-WHO	
Stunted	44 (18.7)
Normal	191 (81.3)
WHZ-WHO	
Wasted	40 (17.0)
Normal	195 (83.0)
WAZ-WHO	
Underweight	43 (18.3)
Normal	192 (81.7)
Characteristics of parents/Guardian	
Mean age (SD)	30.1 (17.1)
Age group	
<30	121 (51.5)
30-39	82 (34.9)
40-49	24 (10.2)
>50	8 (3.4)
Marital status	
Single	29 (12.3)
Co-habiting	40 (17.0)
Married	149(63.4)
Divorced	11 (4.7)
Widowed	6 (2.6)
Religion	
Christians	223 (94.9)
Muslim	7 (3.0)
Traditional	5 (2.1)
Parity	
1	46 (19.6)
2	60 (25.5)
3	47 (20.0)
4	43 (18.3)
5 and above	39 (16.6)
Educational level	
No formal education	50 (21.3)
Primary/JHS	154 (65.5)
SHS	22 (9.4)
Tertiary	9 (3.8)
Occupation	
Unemployed	45 (19.2)
Artisan	55 (23.4)
Civil servant	9 (3.8)
Farming	82 (34.9)
Trading	44 (18.7)

Child feeding practices, dietary diversity and mother's SP-IPTp and iron supplementation during pregnancy:

Table 2 shows that only 86 (36.6%) of the children benefited from exclusive breastfeeding. In a typical day, 25 (10.6%) of the children did not eat food containing iron. Food containing iron alone was consumed by100 (42.6%), Iron + Vitamin B12 was consumed by 36 (15.3%), Iron + Vitamin B12 + Folate was consumed by 27 (11.5%) and food containing Folate + Iron was consumed by 47 (20.0%) of the children. Coverage of Sulphadoxine-Pyrimethamine (SP) for prevention of malaria in pregnancy (SP-IPTp) and iron supplementation during pregnancy at Antenatal care (ANC) were high. A total of 222 (94.5%) of the mothers took SP-IPTp. The same number 222 (94.5%) received iron supplements during pregnancy.

Table 2. Biological characteristics of children 6 to 59 months

Characteristic	Frequency [N=235] n (%)
Anaemia (Hb<11.0 g/dl)	113 (48.1)
No anaemia	122 (51.9)
Anaemia by Age group (in months)(5 categories)	
6-11	38 (16.2)
12-23	59 (25.1)
24-35	32 (16.6)
36-47	45 (19.1)
48-59	61 (26.0)
Age group (in months) 2 categories)	
6-23	55 (48.7)
24-59	58 (51.3)
Haemoglobin level (Hb) (g/dl)	
Mean Hb (SD)	10.8 (1.70)

Low Hb (Hb<8.0g/dl)	17 (7.2)
Mild anaemia (8.0-10.9)	96 (40.9)
Normal(≥11.0)	122 (51.9)
Malaria parasitaemia (RDT)	
Positive	84 (35.7)
Negative	151(64.3)
Malaria parasitaemia (microscopy)	
Positive	40 (17.0)
Negative	195 (83.0)
Axillary temperature(°C)	
Mean(SD)	36.4 (4.9)
Normal (<37.5°C)	220 (93.6)
Fever (≥37.5°C)	15 (6.4)
Exclusively breastfed	
No	149 (63.4)
Yes	86 (36.6)
Sleep inside LLIN	
No	62 (26.4)
Yes	173 (73.6)
Iron Supplements during Pregnancy	
No	13 (5.5)
Yes	222 (94.5)
SP during pregnancy	
No	13 (5.5)
Yes	222 (94.5)
Typical day diet	
None	25 (10.6)
Iron	100 (42.6)
Iron + Vitamin B12	36 (15.3)
Iron + Folate + Vitamin B12	27 (11.5)
Folate + Iron	47 (20.0)

Prevalence of malaria, fever and anaemia:

Table 2 shows that the prevalence of malaria as indicated by RDT was 84 (35.7%) and by microscopy was 40 (17.0%).Mean axillary temperature was 36.4±4.9 and fever (temperature≥37.5°C) was 15 (6.4%) (Figure 1). Overall, anaemia (Hb<11.0gm/dl) was113 (48.1%) with 96 (40.9%) having mild anaemia (8.0-10.9) and 17(7.2%) lowHb (Hb<8.0 g/dl) (Table 2&Figure 1).The mean Hb was 10.8±1.70.

The prevalence of anaemiain children aged 6-23 months was higher 55 (56.7%) than in children 24-59 months 58 (42.0%) (χ^2 =4.91, p=0.027) (Table 3;Figure 2). There was a significant association between malaria and anaemia. Ofthe40 children who tested positive for malariabymicroscopy,27 (67.5%) of were anaemic and of the 195 who tested negative 86(44.1%) were anaemic(χ^2 =7.28, p=0.007) (Figure 2).There was also a significant association between age group and anaemia. Of the 97 children aged 6-23 months, 55 (56.7%) were anaemiccompared to 58 (42.0%) of the 138 children aged 24-59 months (χ^2 =4.91,p=0.027) (Figure 3).

Table 3. Association between independent variables of child and parent/guardian and anaemia (N=235)

Characteristics	Total (n)	Anaemia n (%)	No anaemia n (%)	Chi square (p-value)
Age group (in months) (5 categories)				
6-11	38	21 (55.3)	17 (44.7)	
12-23	59	34 (30.1)	25 (20.5)	
24-35	32	17 (15.0)	15(12.3)	
36-47	45	21 (18.6)	24 (19.7)	
48-59	61	20 (17.7)	41(33.6)	9.02 (0.061)
Age group (in months) (2 categories)				
6-23	97	55 (56.7	42 (43.2)	
24-59	138	58 (42.0)	80 (58.0)	4.91 (0.027)
Sex of child				
Male	114	57 (67.5)	57 (46.7)	
Female	121	56 (49.6)	65 (53.3)	0.32 (0.568)
Malaria (Microscopy)				
Positive	40	27 (23.9)	13 (10.7)	
Negative	195	86 (76.1)	109 (89.3)	7.28 (0.007)
Child use LLIN				
No	62	32 (28.3)	30 (24.6)	
Yes	173	81(71.7)	92 (75.4)	0.42 (0.517)
Exclusively Breastfed				
No	149	66 (58.4)	83 (68.0)	
Yes	86	47 (41.6)	39 (32.0)	2.34 (0.126)
Age parent/guardian				
<30	121	59 (48.4)	62 (54.9)	
30-39	82	39 (32.0)	43 (38.1)	
40-49	24	20 (16.4)	4 (3.5)	

>50	8	4 (3.3)	4 (3.5)	10.61 (0.014)
Iron Supplements during pregnancy				
No	13	7 (6.2)	6 (4.9)	
Yes	222	106 93.8)	116 (95.1)	
SP during pregnancy				
No	13	5 (4.4)	8 (6.6)	
Yes	222	108(95.6)	114 (93.4)	0.51 (0.475)
Socio-economic status (SES)				
Low SES	192	95 (84.1)	97 (79.5)	
High SES	43	18 (15.9)	25 (20.5)	0.82 (0.366)
Parity				
1	46	26 (23.0)	20 (16.4)	
2	60	31 (27.4)	29 (23.8)	
3	47	17 (15.0)	30 (24.6)	
4 and above	82	39 (34.5)	43 (35.6)	4.30 (0.231)
Food content				
None	25	13 (11.5)	12 (9.8)	
Iron	100	52 (46.0)	48 (39.3)	
Iron + Vitamin B12	36	19 (16.8)	17 (13.9)	
Iron+Vitamin B12+Folate	27	9 (8.0)	18 (14.6)	
Folate + Iron	47	20 (17.7)	27 (22.1)	4.01 (0.404)

*p-value shows the differences in prevalence across various groups within each category

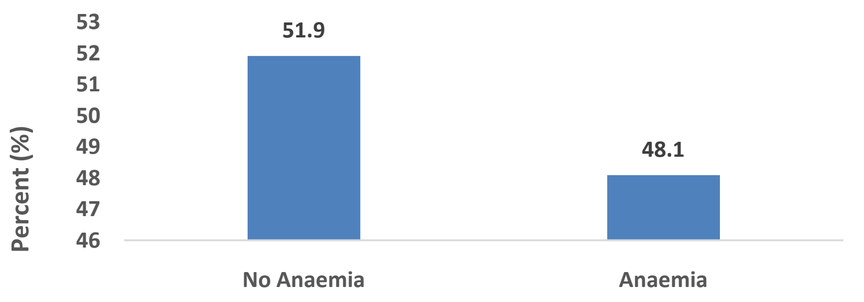

Figure 1. Prevalence of anaemia among children under five years

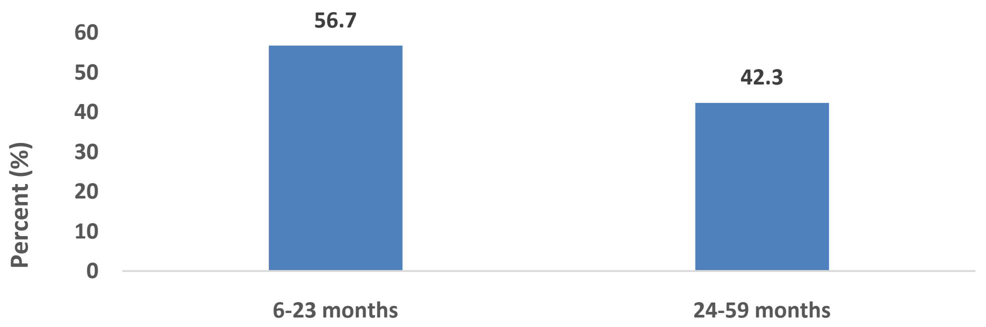

Figure 2. Comparison of anamia prevalence between children aged 6-23 months and thosed aged 24 months and above

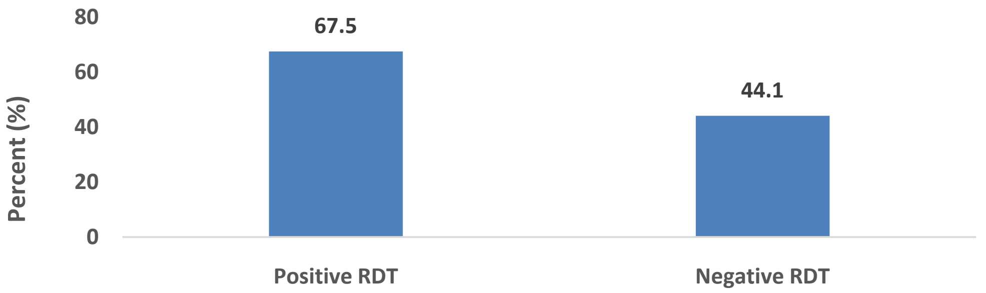

Figure 3. Prevalence of anaemia among children who tested positive and negative for RDT

Socio-economic status of parents/guardians:

The parents/guardians were asked about their educational background and whether they owned a television set, refrigerator, cellular phone, motorbike or bicycle. The scoring ranged between 0 and 4 depending on the number of assets owned by the respondents. Ownership of an asset attracted a score of 1. For instance, one who owned a refrigerator and a cellular phone scored 2. Educational level was also grouped into four categories; no education, primary education/ JHS, secondary and tertiary education with the scores 0, 1, 2, 3and 4 respectively (Table 3). Respondents were scored low socio-economic status if they scored 0 to3 and high socio-economic status with scores of 4 to8. Of the 192 parents/guardians who had Low SES status 95 (84.1%) of their children had anaemia and of the 43 with high SES,15.9% of their children had anaemiaas shown in Table 3.

Association between the independent variable of the child and parent/guardian and the odds of anaemia:

Table 4 shows that children who tested negative for malaria parasitaemia by microscopy were 0.25 times less likely to have anaemia when compared with those who tested positive [AOR=0.25 (95% CI: 0.10, 0.59); p=0.001].Even though not statistically significant, children aged 48-59 months were 0.39 times less likely to develop anaemia as compared to the younger age group[AOR=0.39(95% CI:0.17, 0.91);p=0.061].Children of parents/guardians aged40-49 years were 0.16 times less likely to develop anaemia as compared to those aged less than 30 years [AOR=0.16(95% CI: 0.05, 0.58); p=0.005].

Table 4. Binary logistic regression of the effect of the independent variable of the child on anaemia

Characteristics	Anaemia [n=113]	No anaemia [n=122]	Total [N=235]	Chi square (p-Value)	Unadjusted COR (95% CI)	AOR (95% CI)
Community size						
Small	58 (51.3)	53 (43.4)	111 (47.2)			
Large	55 (48.7)	69 (56.6)	124 (52.8)	1.46 (0.226)	0.30 (0.43, 1.22) 0.227	
Landscape						
Highland	39 (34.5)	37 (30.3)	76(32.3)			
Lowland	74(65.5)	85 (69.7)	159 (67.7)	0.47 (0.493)	0.83 (0.48, 1.43) 0.493	
Age groups						
6-23	55 (48.7	42 (34.4)	97 (41.3)			
24-59	58 (51.3)	80 (65.6)	138 (58.7)	4.91 (0.027)	0.55 (0.33, 0.94) 0.027	0.64 (0.35, 1.18) 0.152
6-11	21 (18.6)	17 (13.9)	38 (16.2)			
12-23	34 (30.1)	25 (20.5)	59 (25.1)		1.10 (0.48, 2.50) 0.819	1.19 (0.47, 3.01) 0.715
24-35	17 (15.0)	15(12.3)	32 (16.6)		0.92 (0.36, 2.36) 0.858	1.33 (0.45, 3.89) 0.606
36-47	21 (18.6)	24 (19.7)	45 (19.1)		0.71 (0.30, 1.69) 0.436	0.96 (0.35, 2.61) 0.932
48-59	20 (17.7)	41(33.6)	61 (26.0)	9.02 (0.061)	0.39 (0.17, 0.91) 0.029	0.39 (0.14, 1.04) 0.061
Sex of child						
Male	57 (50.4)	57 (46.7)	114 (48.5)			
Female	56 (49.6)	65 (53.3)	121 (51.5)	0.32 (0.568)	0.86 (0.52, 1.44) 0.569	
Malaria (Microscopy)						
Positive	27 (23.9)	13 (10.7)	40 (17.0)			
Negative	86 (76.1)	109 (89.3)	195 (83.0)	7.28 (0.007)	0.38 (0.19, 0.78) 0.008	0.25 (0.10, 0.59)< 0.001
Own LLIN						
No	16 (14.2)	21 (17.2)	37 (15.7)			
Yes	97 (85.8)	101 (82.8)	198 (84.3)	0.41 (0.521)	1.26 (0.62, 2.56) 0.521	
Child use LLIN						
No	32 (28.3)	30 (24.6)	62 (26.4)			
Yes	81(71.7)	92 (75.4)	173 (73.7)	0.42 (0.517)	0.83 (0.46, 1.48) 0.517	0.78 (0.40, 1.49) 0.444
Temperature(°C)						
Normal	109 (96.5)	111 (91.0)	220 (93.6)			
Fever	4 (3.5)	11 (9.0)	15 (6.4)		0.37(0.11, 1.20) 0.097	
Exclusively Breastfed						
No	66 (58.4)	83 (68.0)	149 (63.4)			
Yes	47 (41.6)	39 (32.0)	86 (36.6)	2.34 (0.126)	1.52(0.89, 2.58) 0.127	
Age parent/guardian						
<30	59 (48.4)	62 (54.9)	121 (51.5)			
30-39	39 (32.0)	43 (38.1)	82 (34.9)		0.84 (0.47,1.50) 0.556	0.90 (0.44, 1.85) 0.784
40-49	20 (16.4)	4 (3.5)	24 (10.2)		0.32 (0.10, 1.02) 0.055	0.16 (0.05, 0.58) 0.005
>50	4 (3.3)	4 (3.5)	8 (3.4)	10.61 (0.014)	0.71 (0.15,3.28) 0.661	1.27 (0.25, 6.43) 0.766
Educational level of caregivers						
None	26 (23.0)	24 (19.7)	50 (21.3)			
Primary/JHS	75 (66.4)	79 (64.7)	154 (65.5)		0.87 (0.46, 1.65) 0.685	
SHS	7 (6.2)	15 (12.3)	22 (9.4)		0.43 (0.15, 1.24) 0.118	
Tertiary	5 (4.4)	4 (3.3)	9 (3.8)	2.86 (0.413)	1.15 (0.27, 4.80) 0.844	
Occupation						
Unemployed	18 (15.9)	27 (22.1)	45 (19.2)			
Artisan	26 (23.0)	29 (23.8)	55 (23.4)		1.34 (0.60, 2.98) 0.467	
Farming	41 (36.3)	41 (33.6)	82 (34.9)		1.50 (0.71, 3.13) 0.281	
Trading	25 (22.1)	19 (15.6)	44 (18.7)		1.97 (0.84, 4.59) 0.114	
Civil servant	3 (2.6)	6 (4.9)	9 (3.8)	3.44 (0.487)	0.75 (0.17, 3.39) 0.709	
Marital status						
Single	19 (16.8)	16 (13.1)	35 (14.9)			
Married	90 (79.7)	99 (81.2)	189 (80.4)		0.77 (0.37, 1.58) 0.469	
Divorced	4 (3.5)	7 (5.7)	11 (4.7)	1.16 (0.560)	0.48 (0.12, 1.95) 0.305	
Iron Supplements during Pregnancy						

No	7 (6.2)	6 (4.9)	13 (5.5)			
Yes	106 93.8)	116 (95.1)	222 (94.5)		0.78 (0.26, 2.40) 0.669	
SP during pregnancy						
No	5 (4.4)	8 (6.6)	13 (5.5)			
Yes	108(95.6)	114 (93.4)	222 (94.5)	0.51 (0.475)	1.52 (0.48, 4.78) 0.478	
Mother use net during pregnancy						
No	16 (14.2)	18 (14.8)	34 (14.5)			
Yes	97 (85.8)	104 (85.3)	201 (85.5)	0.02 (0.897)	1.05 (0.51, 2.17) 0.897	
Socio-economic status (SES)						
Low SES	95 (84.1)	97 (79.5)	192 (81.7)			
High SES	18 (15.9)	25 (20.5)	43 (18.3)	0.82 (0.366)	0.73 (0.38, 1.43) 0.366	
HAZ-WHO						
Stunted	25 (22.1)	19 (15.6)	44 (18.7)			
Normal	88 (77.9)	103 (84.4)	191 (81.3)	1.65 (0.198)	0.65(0.34, 1.26) 0.200	
WHZ-WHO						
Wasted	17 (15.0)	23 (18.9)	40 (17.0)			
Normal	96 (85.0)	99 (81.2)	195 (83.0)	0.60 (0.438)	1.31 (0.66, 2.61) 0.438	
WAZ-WHO						
Underweight	21 (18.6)	22 (18.0)	43 (18.3)			
Normal	92 (81.4)	100 (82.0)	192 (81.7)	1.65 (0.198)	0.96 (0.50, 1.87) 0.913	
Parity						
1	26 (23.0)	20 (16.4)	46 (19.6)			
2	31 (27.4)	29 (23.8)	60 (25.5)		0.82 (0.37, 1.78) 0.619	0.93 (0.40, 2.18) 0.879
3	17 (15.0)	30 (24.6)	47 (20.0)		0.43 (0.19, 1.00) 0.051	0.40 (0.16, 1.03) 0.058
4 and above	39 (34.5)	43 (35.6)	82 (34.9)	4.30 (0.231)	0.69 (0.33, 1.44) 0.331	1.05 (0.42, 2.65) 0.918
Food content						
None	13 (11.5)	12 (9.8)	25 (10.6)			
Iron	52 (46.0)	48 (39.3)	100 (42.6)		1.00 (0.42, 2.40) 1.000	1.13 (0.42, 3.02) 0.812
Iron + Vitamin B12	19 (16.8)	17 (13.9)	36 (15.3)		1.03 (0.37, 2.86) 0.952	1.33 (0.42, 4.16) 0.625
Iron+Vitamin B12+Folate	9 (8.0)	18 (14.6)	27 (11.5)		0.46 (0.15, 1.42) 0.176	0.89 (0.24, 3.30) 0.868
Folate + Iron	20 (17.7)	27 (22.1)	47 (20.0)	4.01 (0.404)	0.68 (0.25, 1.81) 0.455	0.84 (0.26, 2.59) 0.757

DISCUSSION

The results of the current study revealed that the prevalence of anaemia (Hb<11.0g/dl) in children under five in rural areas in Hohoe municipality was 48.1% with mean Hb (10.8±1.70).This finding is lower compared to the overall prevalence of anaemiareportedearlier in the rural areas of Ghana, 74% [2,11].This improvement could be due to the high LLIN ownership and usage, high coverage of antenatal care clinics attendance by pregnant women, high SP-IPTp and iron supplements uptake during pregnancy, which has resulted in good iron stores in both the mother and child. It could also be due to the clearance of parasitaemia in the blood through prompt treatment with effective antimalarial drugs. Parasitaemia by RDT was 35.7% but by microscopy, it was 17.0%, whichimplies that more than half of those who had parasitaemia might have received treatment.

Thes current study found a decrease in low haemoglobin (Hb<8.0g/dl) (7.2%) as compared to 12.0%recorded in the same area in 2006 and 8.9% in 2010[16The current study found a significant association between age and anaemia. The prevalence of anaemia among children aged 6-23 was 56.7% as compared to 42.3% in children aged 24-59 months (p=0.027). Similar findings were reported earlier, where the prevalence of anaemiaamong children under 2 years was 85.1% and 74 8% among children 2-5 years of age (p<0.001) [2].

On the contrary, a study in Cuba reported a lower (28.5%) prevalence of anaemia in children in in the rural provinces [9]. Another study in Brazil also reported 36.6% prevalence of anaemia in children a rural area [17]. A study conducted in Western Uganda also showed a prevalence of 26.2% [10]. The increased prevalence in the current study could be due to geographical variations or the time the survey was carried out. It could also be due to adherence to exclusive breastfeeding for six monthsanduse of fortified foods containing iron, vitamin B12 and folatefor children.

In the current study, no significant association was found between males and females and anaemia. This finding is inconsistent with a study conducted in Kenya, which revealed thatanaemia was significantly higher in male than female children (p<0.001) [5].In the current study, though there was no significant association, children aged 48 to 59 months compared to those less age 6-11 months were 61% times less likely to develop anaemia as compared to the children aged 6-11 months (AOR=0.39, p=0.061). This finding is consistent with a study conducted in Haiti where children under 24 months were 2.6 times more likely to develop anaemia as compared to the older age (OR=2.6;P<0.001) [18].Another study conducted in Brazil also reported that children aged 24-35, 36-47 and 48-59 months were 0.61, 0.49 and 0.41 times less likely to develop anaemia [17].Another study conducted in North eastern Brazil also revealed that there was a significant association between children aged (6 to 23 months) and anaemia p<0.001) [8].The dietary sources of iron are very important to keep up with the rapid rate of red blood cell synthesis, since anaemia may result if thedietary sources are inadequate [8,20].

Malaria is the most common parasitic infection associated with anaemia [21]. In the current study, children who tested negative for malaria parasitaemia were75% times less likely to develop anaemia (AOR=0.25, p<0.001). A study conducted in Kenya revealed thatthere was a significant association between malaria and anaemia and children were 4 times more likely to be prone to anaemia(p<0.001) [5]. Other similar findings reported in a study conducted in Bata district in Equatorial Guinea revealed that moderate and severe anaemia prevalence was higher among children who tested positive for malaria using RDT (P<0.001) [22]. This could be because the parasites attack the red blood cells through different mechanisms such as red blood cell lysis, organ sequestration and destruction of erythrocytes, phagocytosis of uninfected and infected red blood cells and dyserythropoiesis. When the cells are destroyed, it reduces the number of cells thereby causing anaemia in children[23].

The prevalence of malaria in the current study was 17% and this has also decreased as compared to the 25.5% reported by GDHS, (2014)[11].In the current study, even though the use of LLIN was high, there was no significant association between children who slept insideanLLINand anaemia (AOR=0.78, p=0.444). A study conducted in Bata district in Equatorial Guineaalsofoundthat children who usedLLINs were less likely to have as evere presentation of anaemia [22]. The use of LLIN may be protective against anaemia since it protects the child against malaria infections which can lead to anaemia.

In the current study, children of mothers who were aged between 40-49 years were 84% times less likely to haveanaemia compared to those aged less than 30 years. A similar finding was reported in Uganda where 2 out of every 3 children of young mothers had anaemia [18]. Another study in Northeastern Brazil also showed that children of mothers aged less than 20 years were 1.7 times more likely to have anaemia compared to older age group (p<0.001) [8]. This could probably be due to the fact that young mothers have challenges with child care due to limited resources and experience with child care.

The current study did not find any significant difference between children who consumed food rich in iron, vitamin B12 and folate, and folate plus iron and developing anaemia. This could be due to the fact that information was obtained from mothers and no observation was made or food analysis was done.

LIMITATION OF THE STUDY

Other causes of anaemiain children under five include hookworm and other Helminthes and genetic conditions. However, the current study did not consider worm infestation as a risk factor of anaemia. Another Limitation is that information was only obtained from parents on typical day food consumption, LLIN usage, use of SP-IPTp during pregnancy; and there could be recall bias.

CONCLUSION AND RECOMMENDATIONS

The prevalence of anaemia in children under-five in rural Hohoe Municipality is lower than that of rural Ghana, with the highest prevalence falling within the age group of 6to 23months. Five (5) out of 10 children in rural Hohoe Municipality have anaemia as compared to 7 out of 10 children in rural Ghana. This is probably due to a high LLIN usage, SP-IPTp and iron supplementation coverage and prompt treatment of malaria with effective drugs. Age of parents/guardians and malaria parasitaemia are factors significantly contributing to anaemia.Future interventions in the selected field site would include promotion of foods containing iron, Vitamin B12 and folate, continuous use of LLIN and intermittent preventive treatment of asymptomatic malaria. Further studies would be required to observe and analyse foods consumed by children under five in the Hohoe Municipality

List of abbreviations:

WHO: World Health Organization, LLIN: Long Lasting Insecticide Treated Net, GDHS: Ghana Demographic Health Survey, UHAS: University of Health and Allied Science, SPH: School of Public Health, CHPS: Community-based Health Planning and Services, HMMD: Hohoe Municipal Meteorological Department, EPI: Expanded Programme on Immunisation, HRP2: Histidine-rich Protein 2, WBCs: White Blood Cells, MUAC: Mid-Upper Arm Circumference, GHS: Ghana Health Service, ERC: Ethical Review Committee, GHS-ERC: Ghana Health Service Ethical Review Committee, JHS: Junior High School, SHS: Senior High School. MoH: Ministry of Health HMHD: Hohoe Municipal Health Directorate, SP: Sulphadoxine-pyrimethamine, IPTp: Intermittent preventive treatment in pregnancy, ANC: Antenatal Care, RDT: Rapid Diagnostic Test

Availability of data and material:

Available upon request

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The authors declare that they have no competing interests

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MK and PAP conceived the study. MK, PAP WA, WT, RO, MA did the data analysis and wrote the methods section. MK, PAP, WT and ET were responsible for the initial draft of the manuscript. All authors reviewed and approved the final version of the manuscript.

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REFERENCES

[1]. McLean E, Cogswell M, Egli I, Wojdyla D, De Benoist B. Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993–2005. PublicHealth Nutrition. 2008; vol. 12, no. 4, pp. 444–454.

[2]. Ewusie JE, Ahiadeke C, Beyene J, Hamid JS. Prevalence of anaemia among under-5 children in the Ghanaian population: estimates from the Ghana Demographic and Health Survey. BMC Public Health. 2014; 14:626. (Availablehttp://www.biomedcentral.com/1471-2458/14/626).

[3]. Semedo RML, Santos MMAS, Baião MR, Luiz RR, & da Veiga GV. Prevalence of Anaemia and Associated Factors among Children below Five Years of Age in Cape Verde, West Africa. Journal of Health, Population, and Nutrition. 2014; *32*(4), 646–657.

[4]. Scott PS, Chen-Edinboro P, Caulfield LE, & Murray-Kolb EL. The Impact of Anemia on Child Mortality. 2014; pp 24-34.

[5]. Ngesa O &Mwambi H. Prevalence and Risk Factors of Anaemia among Children Aged between 6 Months and 14 Years in Kenya. PLoS ONE. 2014; *9*(11), e113756.http://doi.org/10.1371/journal.pone.0113756 (4), 444–454. http://doi.org/10.1017/5136980008002401.

[6]. Egbi G, Steiner-Asiedu M, Saalia KF, Ayi I, Ofosu W, Setorglo J, Klobodu SS, Armar-Klemesu M. Anaemia among school children older than five years in the Volta Region of Ghana. Pan Afr Med J. 2014; 17(Supp 1):10. (Available on http://www.panafrican-med-journal.com/content/series/17/1/10/full).

[7]. OforiFosu M, Osei Frimpong F, &Ofori Arthur M. Factors Associated with Haemoglobin Prevalence among Ghanaian Children Aged 6 – 59 months. Journal of Biology, Agriculture and Healthcare. 2014; *4*(2), 9.

[8]. Leal LP, Filho MB, Cabral de LiraI PC, FigueiroaII JN, OsórioI MM. Prevalence of anaemia and associated factors in children aged 6-59 months in Pernambuco, Northeastern Brazil. Revista de SaúdePública. 2011;*45*(3), 457–466. http://doi.org/10.1590/S0034-89102011000300003.

[9]. Pita G, Jimenez S, Basabe B, Garcia R, Marcias C, Selva L, Hernandez C., …Herrera D. Anemia in Children under five years in Eastern Cuba, 2005-2011. 2014 MEDICC review 16(1).

[10]. Kikafunda J, Lukwago FB, Turyashemererwa F. Anaemia and associated factors among under five and their mothers in Bushenyi district, Western Uganda. Public Health Nutrition*.* 2009;12(12):2302-8.

[11]. GDH. Ghana Demographic and Health Report 2014. Ghana Health Service/Ghana Statistical service.

[12]. Hohoe Municipal Health Directorate annual report 2014.

[13]. Hohoe Municipal Meteorological Department Annual Report, 2013

[14]. Degu G, Tessema F. Biostatistics for Health Science Students: lecture note series. The Carter Center 9EPHTI), Addis Ababa; January 2005.

[15]. Drakeley CJ, Jawara M, Targett GAT, Walraven G, Obisike U, Coleman R, Pinder M, Sutherland CJ. Addition of artesunate to chloroquine for treatment of Plasmodium falciparum malaria in Gambian children causes a significant but short-lived reduction in infectiousness for mosquitoes. Trop. Med. Int. Health. 2004; 9:53-61.

[16]. Kweku M, Appiah EK, Takramah W, Enuameh Y, Norman I, Binka F. Effect of a Malaria Control Program on the Prevalence of Malaria, Fever and Anaemia in Children under Five Years in the Hohoe Municipality of Ghana: A Comparative Analysis of Cross-Sectional Surveys. Advances in Infectious Diseases. 2015; 5, 180-188

[17]. Leite M, Cardoso A, Coimbra C, Welch J, Gugelmin S, Lira PC, Horta B, Santos R, Escobar A. Prevalence of anemia and associated factors among indigenous children in Brazil: results from the First National Survey of Indigenous People's Health and Nutrition. 2013; Nutr J. 12(1):69.

[18]. Ayoya MA, Ngnie-Teta I, Raphin MN, Mamadoultaibou A., Boldon E, Saint-Fleur JE, Koo L, Bernard S. Prevalence and risk factors of anaemia among children 6 to 59 months Old in Haiti; 2013 *Anemia*.3.

[19]. Kuziga F, Adoke Y, Wanyenze. Prevalence and factors associated with anaemia among children aged 6 to 59 months in Namutumba district, Uganda: a cross-sectional study. BMC Pediatr. 2017; 17:25.

[20]. Cardoso MA, Scopel KK, Muniz PT, Villamor E, Ferreira MU. Underlying factors associated with anaemia in Amazonian children: a population-based, cross-sectional study. PLoS One. 2012; 7(5):e36341.

[21]. Brooker S, Akhwale W, Pullan R, Estambale B, Clarke S et al. Epidemiology of plasmodium helminth co-infection in Africa: populations at risk, potential impact on anaemia, and prospects for combining control. Am J Trop Med Hyg. 2007; 77: 88–98.

[22]. Ncogo P, Romay-Barja M, Benito A, Aparicio P, Nseng G, Berzosa P, …Herrador Z. Prevalence of anaemia and associated factors in children living in urban and rural settings from Bata District, Equatorial Guinea, 2013.PLoS ONE. 2017; 12(5):e0176613. http://doi.org/10.1371/journal,pone.0176613.

[23]. Kai OK, Roberts DJ. The pathophysiology of malarial anaemia: where have all the red cells gone? *BMC Med* 2008; 6:24.