Prevalence of Intestinal Parasite Infection and its Association with Anemia among Children Aged 6 to 59 Months in Sidama National Regional State, Southern Ethiopia

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ABSTRACT

BACKGROUND: Previous studies conducted in Ethiopia revealed anemia as a severe public health problem among under-5 children but failed to associate with parasite infection. This study was aimed at assessing the prevalence of intestinal parasite infection (IP) and its association with anemia among children aged 6 to 59 months in Yirgalem General Hospital, Southern Ethiopia.

METHOD: Institution based cross-sectional study was conducted in 2020 on 367 children aged 6 to 59 months. Trained data collectors administered the questionnaire. Blood was collected and analyzed for hemoglobin using the HemoCue 301. The stool samples were collected and analyzed. Association between IP and anemia was measured using multivariable analysis. The outputs are presented using an adjusted odds ratio (AOR) with 95% confidence intervals.

RESULTS: The prevalence of anemia was 48.8% (95% CI: 43.7, 53.9). Anemia was of mild, moderate, and severe type in 24.5%, 21.5%, and 2.8% of the children respectively. The prevalence of IP was 43.3% (95% CI: 38.2, 48.3). The odds of anemia were higher among children infected with IP (AOR = 3.19, 95% CI: 1.97, 5.17), large family size (AOR = 2.13, 95% CI: 1.26, 3.59), low-income level (AOR = 2.05, 95% CI: 1.25, 3.35), and MUAC < 11 cm (AOR = 3.27, 95% CI: 1.85, 5.81).

CONCLUSIONS: The prevalence of IP was high. Anemia has severe public health significance. IP infection, income level, family size, and MUAC level were associated with anemia in children. Strengthening existing programs to prevent childhood anemia, and IP recommended.

KEYWORDS: Parasite infection, anemia, children, association, Yirgalem General Hospital

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Introduction

Childhood anemia is a condition where a child has insufficient red blood cells to provide adequate oxygen to the body tissues.[1] Despite the slight improvement of hemoglobin globally in children from 109 g/L in 1995 to 111 g/L in 2011, anemia affects 273 million under-5 children worldwide, with an even higher prevalence in Sub-Saharan African and South Asia countries.[2,3] The World Health Organization (WHO) estimates 43% of the prevalence of anemia in under-5 children, considering it as a severe public health problem.[3]

Intestinal parasite infections are the most common infections that affect the poorest and most deprived communities in the world. Sub-Saharan Africa, China, and East Asia are areas where infections widely distributed. More than 1.5 billion people (24% of the world's population) are infected by helminths; from these, 267 million are under-5 age children.[4]

Anemia damaging effects start occurring in the womb and increase the risk of preterm labor. The higher oxygen demands of the pediatric brain make them susceptible to the negative effects of anemia. Anemia increases the risk of low birth weight and may predispose to infection and heart failure.[5] It affects health, brain development, intelligence in early childhood age and reduces educability and productivity in adult age.[6] Anemia has been associated with increased mortality in under-5 age children but 1.8 million deaths could be averted each year by controlling it.[7]

Analysis of causes of anemia associated with numerous coexisting etiologies. The most common cause of anemia in young children is low consumption and absorption of iron-rich foods. These conditions most often lead to iron deficiency anemia, which accounts for approximately 50% of all anemia cases globally in under-5 children and pregnant women.[5,6] Other nutritional deficiencies (folate, vitamin B12, and vitamin A), acute and chronic inflammations, parasitic infections, and inherited or acquired disorders that affect hemoglobin synthesis, red blood cell production, or red blood cell survival have etiological significance.[1,2] Contextual factors including poverty and limited access to health care are also important to root causes.[8,9]

Several studies conducted in different parts of Ethiopia revealed that anemia among under-5 age children is one of the major public health problems in the country but failed to associate with parasite infection. Therefore, this study was intended to determine the prevalence of intestinal parasite infection and its association with anemia among 6 to 59 months age children attending the Pediatric Outpatient Department of Yirgalem General Hospital.

Materials and Methods

Study area and period

This study was conducted from April 1 to June 30, 2020, in Yirgalem General Hospital (YGH) Pediatric clinic. YGH is located in Sidama National Regional State. It is 322 km far from Addis Ababa, the capital city of Ethiopia, and 45 km to Hawassa City, the capital city of the region. YGH is one of the general hospitals in the region and serves around 4.5 million people in the Sidama Region and the neighboring Oromia region.

Study design

A facility-based cross-sectional study was conducted.

Source and study population

All children aged 6 to 59 months who visited the hospital's pediatric outpatient department were the source population. Children selected based on the presence of signs and symptoms of anemia and gastrointestinal tract infections from the department during the data collection period were the study population.

Sample size determination

The sample size for the prevalence of intestinal parasite infection and anemia was calculated separately using single population proportion formula. The computation was made at a 95% confidence level, 5% margin of error, 10% nonresponse rate, 41.1% expected prevalence of anemia,[10] and 18.7% prevalence of intestinal parasite infection.[11] Sample size correction was used and a size of 367 determined to be sufficient.

Sampling procedures

Six to fifty-nine month age children who attended the pediatric outpatient department for medical care during the study period (1 April-30 June 2020) were included using a systematic sampling technique. The calculated sample was used to recruit study subjects. The average number of patients who visited the pediatric outpatient department for medical care daily during data collection period was estimated based on the previous 3 months' daily patient flow of the department which was obtained by referring registration book/record for 3 months prior to the data collection. Selected children's mothers/caretakers were interviewed.

Data collection tools and procedure

Data were collected using a structured, interviewer-administered questionnaire. The questionnaire was prepared in the English language after a different literature review, translated into the local language (Sidamu Afo), and retranslated back to English to check its consistency.

Mid-upper arm circumference (MUAC) measured at the midpoint between the tip of the shoulder and the elbow after the left arm bent at 90° to the body using a flexible measuring tape. Measurement was taken twice and the average value was used for data analysis.

A stool examination was made using a microscope. Single, fresh stool specimens were collected after informing mothers/caretakers how to bring using clean and labeled stool cups. During the examination, a formal ether concentration technique was applied. The direct microscopy method was applied to identify intestinal parasites using the concentration method.

Hemoglobin concentration was measured by taking a finger-prick capillary blood sample of each child using HemoCue 301. A prick was made on the middle finger of the left hand after the site was cleaned with clean cotton and disinfectant. The first drop of the blood was cleaned off and the second drop was collected to fill the micro cuvette which is then placed in the cuvette holder of the device for measuring hemoglobin concentration by laboratory technologists.

Data quality assurance techniques

To assure quality, data collectors and supervisors were trained and the questionnaire was pretested. The completed questionnaire was checked for consistency and completeness daily by principal investigators until data collection completed and then, the correction was given the next morning if any inconsistency/incompleteness observed.

Data processing and analysis

Data were checked for completeness and consistency. Then, coded and entered into SPSS version 26 statistical package for analysis. Descriptive analysis was computed to describe socio-demographic and presented by tables and figures. Hemoglobin was adjusted for altitude.[1] Bivariable and multivariable logistic regression analysis was employed to determine the odds ratio. *P*-values less than .05 were considered statistically significant.

Operational definitions

Anemia: hemoglobin (Hb) level of less than 11.0 g/dl; mild anemia: Hb level 10 to 10.9 g/dl; moderate anemia: Hb level 7 to 9.9 g/dl; severe anemia: Hb level <7 g/dl.[1]

Undernutrition: Mid-upper arm circumference (MUAC) measurement of 6 to 59 month age children less than 11 cm.[12]

Results

Socio-demographic characteristics

In this study, a total of three sixty-seven 6 to 59 months of age 189 (51.5%) female and 178(48.5%) male children participated making the response rate 100%. The mean (±standard deviation) age of the children was 28 (±16.6) months. About 299 (81.5%) of children's parents lived in rural areas. Two third of parents, 250 (68.1%) were Sidama in ethnicity; with regard to religion, 338 (92.1%) were protestants. Of those children's parents, 165 (45%) of mothers and 132 (36%) of their fathers have not attended formal education whereas more than half, 209 (57%) mothers/caretakers were housewives. The median monthly income of the family in a typical month was 2000 Eth birr and ranged from 600 to 3610 Ethiopian birr. Two-thirds of the parents, 245 (66.8%) had greater than 4 family members (Table 1).

Table 1. Socio-demographic and economic characteristics of children's parent in Yirgalem General Hospital, Sidama Region, Southern Ethiopia, 1 April to 30 June 2020.

VARIABLES (N = 367)	CATEGORY	FREQUENCY	PERCENT (%)
Parent's ethnic group	Sidama	250	68.1
	Oromo	54	14.7
	Amhara	63	17.2
Parent's religion	Protestant	338	92.1
	Orthodox	15	4.1
	Muslim	14	3.8
Parent's place of residence	Rural	299	81.5
	Urban	68	18.5
Educational level of mothers	Illiterate	165	45
	Primary level	134	36.5
	Secondary level and above	68	18.5
Education level of fathers	Illiterate	132	36
	Primary level	123	33.5
	Secondary level and above	112	30.5
Occupation of mothers	Housewife	209	57
	Merchant	101	27.5
	Government employee	57	15.5
Parent's monthly income	⩾1000 Eth birr	233	63.5
	<1000 Eth birr	134	36.5
Parent's family size	⩽4 member	122	33.2
	>4 member	245	66.8

Intestinal parasite infection

Stool examination identified 7 species of intestine parasites. Among a total of 367 children who participated in this study, 159 (43.3%) (95% CI: 38.2, 48.3) were infected with at least 1 parasite. Seven (1.9%) children were infected with 2 parasites. *Entamoeba histolytica* (*E.histolytica*) was the most prevalent, 42(11.4%) followed by *Ascaris lumbercoides (A.lumbercoides)*, 34(9.3%). *Taenia saginata (T.saginata)* was the least prevalent parasite identified, 9(2.4%) as shown on Figure 1 prevalence of intestinal parasites identified among 6 to 59 month age children in Yirgalem General Hospital, 2020.

Anemia prevalence

The mean hemoglobin level concentration was 11.46 (±1.95) g/dl with a range of 6.24 to 15.85 g/dl. One hundred seventy-nine (48.8%) (95% CI: 43.7, 53.9) 6 to 59 month age children were anemic. Of all children, 2.8%, 21.5%, and 24.5% diagnosed with severe, moderate, and mild anemia respectively. With this prevalence, anemia has severe public health significance in the study area.

Association between intestinal parasites infection and anemia

Anemia was significantly higher among children infected with intestinal parasites (59.2%) compared to those not infected (25.9%) ($P < .001$). Three-fourth of children infected by *Giardia lamblia (G.lamblia) and A.lumbercoides* were anemic. Similarly, the prevalence of anemia was high among children with other intestine parasites: *E. histolytica* (71%) and *hookworms* (44.4%). Chi-square test showed a significant association between anemia and *G.lamblia, A.lumbricoides, E. histolytica*, and *hookworm* infection ($P < .05$).

At bivariable analysis, place of residence, family size, income level, knowledge about intestinal parasite transmission, latrine owning, latrine care, shoes wearing, nail trimming, intestinal parasite infection, complementary food initiation time, consumption of minimum recommended diet diversity (DD), and MUAC showed significant association with anemia. At multivariable analysis, factors that increased the likelihood of anemia included; family size,

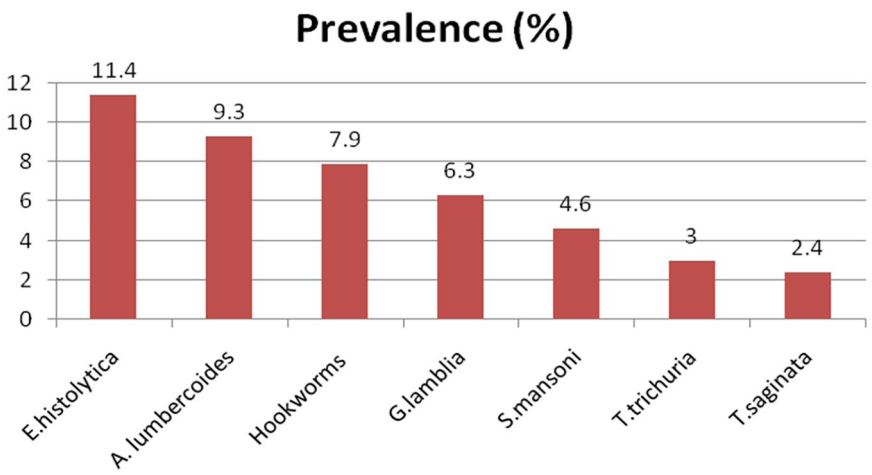

Figure 1. Prevalence of intestinal parasites identified among 6 to 59 month age children in Yirgalem General Hospital, 2020.

income level, intestine parasite infection, and MUAC measurement (Table 1).

The odds of anemia were higher among 6 to 59 month age children with intestinal parasite infection (AOR = 3.19, 95% CI: 1.97, 5.17), large family size (AOR = 2.13, 95% CI: 1.26, 3.59), and low family monthly income level (AOR = 2.05, 95% CI: 1.25, 3.35). Increased odds of anemia were also observed among 6 to 59 month age children with MUAC < 11 cm (undernourished) (AOR = 3.27, 95% CI: 1.85, 5.81) (Table 2).

Discussion

In this study, the overall prevalence of intestinal parasites was 43.3%. The prevalence was higher than previous studies conducted in different parts of Ethiopia namely, Dessie 15.5%,[13] Gondar Hospital 17.3%,[14] Debre Birhan 17.4%,[15] Woreta Health Center 18.7%,[11] and Hawassa 26.6%.[16] This study also showed low prevalence as compared with studies conducted in Wondo Genet, 85.1%.[17] This difference could be due to the difference in geographical location, time of the survey, diagnostic method, and socioeconomic status.

The findings of this study indicated that 48.8% of 6 to 59 months' age children were anemic and with this prevalence, anemia has severe public health significance in the study area. The result is lower than the 2016 Ethiopian Demographic Health Survey (EDHS) report, 57%,[18] further analysis of the 2016 EDHS, 58%,[19] Gondar hospital, 58.6%,[20] Wag-Himra Zone, 66.6%,[21] and Tanzania, 77.2%.[22] The difference in prevalence in different parts of the country might be due to heterogeneity of the studied population, dietary habits, nutritional status, and incidence of worm infestation in defined geographical spots.

This study revealed that children with parasitic infection are about 3 times more likely to have anemia than children who are free from parasitic infection (AOR = 3.19; 95% CI: 1.97, 5.17). This finding is similar to the studies a study done in Gondar hospital,[20] and Nigeria.[23] Increased odds of anemia among children infected with intestinal helminths could be explained in several ways. Intestinal parasites may impair iron status by sucking blood from the intestinal wall, causing acute/chronic intestinal bleeding, causing loss of appetite and reduction of food intake, competing for micronutrients, causing diarrhea/dysentery, and inhibiting vitamin A absorption which plays a role in the hemoglobin synthesis pathway.[9]

This study also showed children from households with large family sizes were more likely to be anemic compared to children from households with smaller family sizes (AOR = 2.13; 95% CI: 1.26, 3.59). This finding was in line with studies carried out in Ethiopia[19,24] and Uganda.[25] Inadequate intake of nutrients might be the reason for higher odds of anemia among children from households with large family size.

The odds of anemia were higher among children from family income levels less than 1000 Eth birr compared to their counterparts. This was consistent with the studies performed in Ethiopia,[10,19,21,26] Cape Verde,[27] Brazil,[28] and Sri Lanka.[29] The main reason for the high level of anemia among children from low-income levels might be low nutrition uptake because the poor families tend to select low-quality food that costs less lacking essential nutrients that contribute to anemia.

Children with a MUAC less than 11 cm showed increased odds of anemia compared with children MUAC ⩾11 cm. This finding was consistent with a study conducted in Northern Ethiopia.[26] This can be explained by the fact that undernourished children have a higher probability of being deficient in micronutrients more likely and develop anemia.

Conclusions and Recommendations

The result of this study indicated that the prevalence of intestinal parasites was high and predominated by *E.histolytica*. The prevalence of anemia among children in the study area was also high and has severe public health significance. Children infected with intestinal parasites had more odds of developing anemia. Children from a family with a low-income level, large family size, and low MUAC measurement level also had higher odds of developing anemia. The Regional Health Bureau collaborating with other responsible bodies should design and

Table 2. Factors associated with anemia among 6–59 month age children in Yirgalem General Hospital, Sidama Region, Southern Ethiopia, 1 April to 30 June 2020.

VARIABLE (N = 367)	CATEGORY	ANEMIA		COR	AOR	*P*-VALUE
		YES	NO			
IP infection	Yes	106	53	3.69 (2.39–5.72)	3.19 (1.97–5.17)	<.001
	No	73	135	1	1	
Place of residence	Rural	156	143	2.13 (1.23–3.70)	1.31 (0.71–2.43)	.389
	Urban	23	45	1	1	
Family size	<5 members	40	82	1	1	.005
	⩾5 members	139	106	2.69 (1.71–4.24)	2.13 (1.26–3.59)	
Income level	⩾1000 Eth birr	85	139	1	1	.004
	<1000 Eth birr	94	49	2.56 (1.56–3.98)	2.05 (1.25–3.35)	
Know about IP transmission	Yes	63	66	1	1	.981
	No	116	122	1.00 (0.65–1.54)	0.99 (0.61–1.63)	
Latrine owning	Yes	63	143	1	1	.551
	No	116	45	1.73 (1.09–2.72)	1.19 (0.67–2.13)	
Latrine care	Mother	85	106	1	1	.637
	Self	94	82	0.85 (0.57–1.29)	1.12 (0.69–1.87)	
Shoes wearing	Yes	87	91	1	1	.995
	No	92	97	0.96 (0.71–1.28)	1.00 (0.59–1.67)	
Nail trimming	Always	73	75	1	1	.896
	Sometimes	106	113	0.96 (0.63–1.46)	0.97 (0.59–1.57)	
Complementary food initiation	<6 months	116	140	1.62 (1.04–2.54)	0.97 (0.55–1.71)	.910
	⩾6 months	64	48	1	1	
Minimum recommended DD	Yes	42	55	1	1	.982
	No	137	133	0.74 (0.46–1.18)	0.99 (0.57–1.72)	
MUAC	<11 cm	104	28	4.12 (2.50–6.79)	3.27 (1.85–5.81)	<.001
	⩾11 cm	75	160	1	1	

strengthen interventions to prevent parasite infection and anemia in childhood age.

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Ethical Approval

Ethical clearance was obtained from the Institutional Review Board of Yirgalem Hospital Medical College. Confidentiality of the respondents was maintained and assured that no problem would they face as this information would not be passed to any third body with identification. The respondents were told the laboratory analysis and physical examination results and provided deworming and nutrition counseling coordinating with hospital staff.

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