

Assessment of prevalence and associated factors of intestinal parasite infections among school children at Amber Primary School, Northwest Ethiopia

SAGE Open Medicine

Volume 10: 1–7

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DOI: 10.1177/20503121221128134

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Abstract

Objective: This study is aimed to assess the prevalence and associated factors of intestinal parasitic infections among school children at Amber Primary School, Northwest Ethiopia.

Methods: A school-based cross-sectional study was conducted at Amber Primary School from December 2019 to January 2020. Semi-structured questionnaire was used to collect socio-demographic data and clinical characteristics. Direct wet mount technique was applied for detection and identification of intestinal parasites.

Result: A total of 384 participants were included in this study of which 50.3% were males and 65.4% were in the age group 9–12 years. The prevalence of at least one intestinal parasite was 26.8% (n = 103), of which 13.6% (n = 14) were mixed infections. *Hymenolepis nana* was the most prevalent intestinal parasite (5.2%) followed by *Entamoeba histolytica/dispar* (4.9%) and hookworm (4.7%). Male children (adjusted odds ratio = 0.624; 95% confidence interval: 0.392–0.993) and those whose mother completed elementary school (adjusted odds ratio = 2.171; 95% confidence interval: 1.012–4.658) were significantly associated with intestinal parasite infections ($p < 0.05$).

Conclusion: Intestinal parasitic infections remained an important health problem among school children in the study area. Appropriate intervention measures should be taken to reduce the burden and related morbidities.

Keywords

Intestinal parasite, Amber, schoolchildren

Date received: 19 February 2022; accepted: 6 September 2022

Introduction

Intestinal parasitic infections (IPIs) caused either by pathogenic helminths or protozoa are the most prevalent in the world mainly in low-income countries like Ethiopia. They are highly prevalent especially among the poor sections of population.^{1–3} About 3.5 billion people are infected globally and more than 10.5 million new cases are reported annually.⁴ Farmers, institutionalized children, and prisoners are the groups of people at high risk of IPI.⁵ In heavy infections, they lead to iron deficiency anemia, vitamin-A deficiency, growth retardation, and organ blockage.^{6,7} Hookworm, *Ascaris lumbricoides*, *Trichuris trichiura*, *Entamoeba histolytica/dispar*, and *Giardia duodenalis* are the commonest intestinal parasites causing high morbidity and mortality in sub-Saharan Africa.^{8,9}

Like other tropical developing countries, intestinal parasites are widely distributed in Ethiopia due to poverty and climatic factors. Nearly 81 million people live in endemic areas, of which 25.3 million are school-age children.¹⁰ There was high prevalence of helminthic infection in the lower altitudes, *Ascaris lumbricoides* being the most predominant intestinal parasite in different localities occurring together with *Trichuris* and hookworm.^{11,12} Intensity of infection may

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be light, moderate, or high depending on the virulence nature of the parasite and host immune status. Commonly, many of the infected persons are asymptomatic at diagnosis and remain undetected, thus difficult to evaluate the burden caused by intestinal parasites.¹³

A cross-sectional study in Northern Ethiopia reported that the prevalence of intestinal parasites among school-age children was 29.9%. Unclean fingernail, defecating in the open field, and being barefooted were identified as the determinant factors.¹⁴ A recent systematic review and meta-analysis reported that the pooled prevalence of IPIs in preschool and school Ethiopian children is 48%.¹⁵ Studying the prevalence of IPIs and its correlates is a precondition for designing appropriate intervention strategies. The disease burden is different from place to place and depends on several predisposing factors. Although several studies have been conducted on prevalence and associated factors of IPI in Ethiopia, there are still localities by which epidemiological information is not known. Therefore, the objective of this study was to assess the prevalence of IPI and associated factors among school children at Amber Primary School, which is found in Northwest Ethiopia.

Materials and methods

Study design and setting

A school-based cross-sectional study was conducted from December 2019 to January 2020 at Amber Primary School located in Amber town. Amber is found in Aneded woreda, East Gojjam zone of Amhara region, which is 285 km far from Addis Ababa, capital city of Ethiopia. The town has an annual average temperature ranging from 18°C to 25°C. There are three cluster kebeles surrounding the town, and one governmental primary school, one high school, and one health center in the town. Based on the 2007 national census conducted by Central Statistical Agency (CSA) of Ethiopia, the town and the surrounding kebeles have a total population of 24,717. The town administration has a total population of 5427.

Study population characteristics

All Amber Primary School children were the source population and those students enrolled in the school during the study period were study population. All voluntary children who submitted a stool specimen were included and those taking anti-parasitic medication were excluded from the study.

Sample size determination and sampling method

The sample size was calculated using single population proportion formula $N = Z^2 p (1-p)/d^2$, where N =minimum number of sample size, Z^2 =standard value, d =marginal error; at 95% confidence interval (95% CI), $Z=1.96$ and $d=5\%$. Since no report was recorded for infection

prevalence of intestinal parasites in the study area, $p=50\%$. Therefore, $N = (1.96)^2 \times 0.5 (1-0.5)/(0.05)^2 = 384$.

Sampling technique

To select the children, the students were first stratified according to their educational level (grade 1 to grade 8). A quota was then allocated for each grade with proportional allocation according to the number of students in each grade. Finally, the participating children were selected using systematic random sampling technique by using class roster as a sampling frame.

Data collection and laboratory methods

Sociodemographic data collection

A semi-structured questionnaire addressing all socio-demographic data and the risk factors was self-made in English version. It was then translated into the local language of the area (Amharic). The questionnaires used in this study were pre-tested in 5% ($n=19$) of population for validation. Finally, interview was conducted by trained data collectors. Their parents/legal guardians were interviewed for questions that are not possible for lower grade (grades 1 and 2) children.

Stool sample collection, processing, and examination

Stool samples were collected into dry, clean, and leak-proof container after appropriate instruction and checked visually for quantity, color, consistency, and appearance. Direct wet mount technique was applied for detection and identification of intestinal parasites. Three smear preparations for each participant were examined carefully and their result is recorded at Amber Health Center Laboratory. Presence of parasite in one of the three smear preparations was reported as positive and absence of parasite from all three smear preparations was reported as negative.

Statistical analysis

Data were entered and analyzed using SPSS version 20.0 (SPSS Inc., Chicago, 2011) software. Univariate and multivariate logistic regression was used for statistical analysis to show any significant association between dependent and independent variables. A p value of <0.05 was considered as statistically significant.

Results

Characteristics of study participants

A total of 384 participants were included in this study, of which 50.3% were males and 65.4% were in the age

Table 1. Sociodemographic characteristic of study participant at Amber Primary School, 2020.

Variables	Category	Frequency	Percentage
Sex	Male	193	50.3
	Female	191	49.7
Age group in years	5–8	65	16.9
	9–12	251	65.4
	13–16	68	17.7
Grade level	1–4	240	62.5
	5–8	144	37.5
Occupation of household head	Governmental employee	66	17.2
	Farmer	156	40.6
	Merchant	108	28.1
	others	54	14
Educational status of household head	Unable to read and write	156	40.6
	Elementary school	109	28.4
	High school	62	16.1
	College and above	57	14.8
Family size	4 and below	97	25.3
	5–7	272	70.8
	8 and above	15	3.9
Source of water	Tap	287	74.7
	Spring	95	24.7
	Other	2	0.5
History of previous infection	Yes	156	40.6
	No	228	59.4

group 9–12 years. Majority of them (62.5%) were in grades 1–4, and 74.7% of participants drank tap water. Majority of them (70.8%) had a family size of five to seven people and 59.4% had no history of previous infection (Table 1).

Prevalence rate of intestinal parasite species

The prevalence of at least one intestinal parasite was 26.8% (95% CI: 22.7–31.3; males 11.4%, females 15.4%). Overall, 23.2% (n=89) were single infections and 3.6% (n=14) were mixed infections. All mixed infections were double infections. A total of six intestinal parasites (two species of protozoa and four species of helminth) were identified. The ratio of protozoa to helminth infection was approximately 1:1.6 in single infections. Highest prevalence rate was observed in *Hymenolepis nana* followed by *E. histolytica/dispar* and hookworm. The highest case of double infection was noticed in *G. duodenalis* and *E. histolytica/dispar* (six cases) followed by hookworm and *E. histolytica/dispar* (three cases; Table 2).

Prevalence rate of IPIs by sex and age

Females (30.9%) had higher parasite prevalence than males (22.8%). Highest parasite infection was observed in the age group 5–8 years (27.7%) and 9–12 years (27.1%; Table 3).

Factors associated with intestinal parasites

Potential variables that showed a p value of <0.25 in the univariate analysis were included in the multivariate model to control confounding factors (Table 4). Six variables (sex, mother's educational status, family size, grade level, nail trimming, and hand washing before eating) were entered into the backward stepwise multivariate logistic regression model (Table 5).

Two variables (sex and mother's educational status) were significantly associated with IPIs ($p < 0.05$). Males were 0.624 times (adjusted odds ratio (AOR)=0.624, 95% CI: 0.392–0.993) less likely to be infected by intestinal parasites than females. Children whose mother completed elementary school were 2.171 times (AOR=2.171, 95% CI: 1.012–4.658) more likely to be infected by intestinal parasites than others (Table 5). The prevalence of intestinal parasite was not significantly associated with age group, grade level, family size, nail trimming, wearing shoes, contact with animals, and hand washing before eating and after defecation ($p > 0.05$).

Discussion

Understanding the status of IPIs and related factors in different setting is vital to identify high-risk groups and design suitable intervention tools. In this study, the prevalence of at least one intestinal parasite was 26.8%. This finding is in line

Table 2. Prevalence rate of intestinal parasite species identified in Amber Primary School, 2020.

Intestinal parasite species		Frequency (N)	Percentage (%)
Mono infections	<i>H. nana</i>	20	5.2
	<i>E. histolytica/dispar</i>	19	4.9
	Hookworm	18	4.7
	<i>Giardia duodenalis</i>	15	3.9
	<i>A. lumbricoides</i>	13	3.4
	<i>E. vermicularis</i>	4	1.1
	Total	89	23.2
Double infections	<i>A. lumbricoides</i> + <i>G. duodenalis</i>	2	0.5
	<i>A. lumbricoid</i> + <i>E. histolytica/dispar</i>	1	0.3
	Hookworm + <i>G. duodenale</i>	1	0.3
	Hookworm + <i>E. histolytica/dispar</i>	3	0.7
	<i>E. histolytica/dispar</i> + <i>G. duodenale</i>	6	1.5
	Hookworm + <i>H.nana</i>	1	0.3
Total		14	3.6
Overall total		103	26.8

Table 3. Prevalence rate of intestinal parasite infections by sex and age in Amber Primary School, 2020.

Category		Positive (%)	Negative (%)
Sex	Male	44 (22.8)	149 (77.2)
	Female	59 (30.9)	132 (69.1)
Age group	5–8	18 (27.7)	47 (72.3)
	9–12	68 (27.1)	183 (72.9)
	13–16	17 (25)	51 (75)
	Total	103 (26.8)	281 (73.2)

with a study conducted in Delo-Mena district, South Eastern Ethiopia (26.6%),¹⁶ Birbir town, Southern Ethiopia (27.1%),¹⁷ and Northern Ethiopia (29.9%).¹⁴ However, it is higher than a study conducted in Harbu Town, Northeast Ethiopia (21.5%),¹⁸ and lower than a studies conducted in Sasiga District, Southwest Ethiopia (62.4%),¹⁹ Jawi Northwest Ethiopia (57.88%),²⁰ Bahir Dar, Ethiopia (65.5%),²¹ and Southern Ethiopia (67.7%)²² Homesha District, Benishangul-Gumuz Region (35.4%),²³ Gurage Zone of Ethiopia (40.2%),²⁴ Aksum town (44.6%),²⁵ and Adigrat town (50.8%).²⁶ A molecular study among diarrheic children in Gabon reported an overall IPI prevalence of 61%, *Hymenolepis* species and *Cryptosporidium hominis/parvum* being the most common parasites (31% and 19%, respectively).²⁷ The difference in prevalence rate might be due to difference in level of knowledge and practice on intestinal parasite, hygienic status of school children, and diagnostic tools used to detect the parasite.

Of the total 26.8% infected, 23.2% were single infections and 3.6% were mixed infections. From this mixed infections, all students had only double infection. A study conducted in Aksum town showed a prevalence rate of 37.6% single and 7% mixed infections among positive cases.²⁵ The present finding is different from a study conducted in Delgi, North Gondar by which 13.6% were single infection and 66.2%

were mixed infection; from this mixed infection, the majority of the students had double infection 43.9%.²⁸ The difference might be due to several environmental, social, and geographical factors.

About six species of intestinal parasites were identified, of which *H. nana* (5.2%) was the predominant parasite followed by *E. histolytica/dispar* (4.9%), hookworm (4.7%), *G. duodenalis* (3.9%), *A. lumbricoides* (3.4%), and *E. vermicularis* (1.1%). A study conducted in Delo-Mena district, South Eastern Ethiopia and Harbu Town, Northeast Ethiopia showed the dominance of *E. histolytica/dispar* followed by *H. nana*.^{16,18} Another study conducted in Delgi, North Gondar demonstrated that the most prevalent intestinal parasites identified were *A. lumbricoides*, *G. duodenalis*, *E. histolytica/dispar*, *S. mansoni*, and hookworm.²⁸ A study done in Adigrat town also showed that frequently encountered intestinal parasites were *A. lumbricoides* (19.1%), hookworm (10.03%), *Strongyloides stercoralis* (7.77%), *E. histolytica* (4.5%), *Enterobius vermicularis*, (3.56%), *T. trichiura* (3.24%), and *G. duodenalis* (2.29%).²⁶

In this study, females (30.9%) had higher parasite prevalence than males (22.8%) and highest IPI was observed in the age groups 5–8 years (27.7%) and 9–12 years (27.1%). The reason is due to the fact that females are more engaged in food preparation and water-fetching activities and lower age children have a habit eating and/or drinking contaminated food/water that might increase the risk of acquiring parasite feco-orally and/or via skin penetration. This is in line with a study conducted in Adigrat town by which higher infection prevalence was seen in females (52.9%) than in males (49.1%) and the highest IPI was observed in age group 10–12 (54.8%).²⁶ IPI was significantly associated with sex (being male) and mother's educational status (elementary school; $p < 0.05$). Males were less likely to acquire infection than females. A study done in Southern Ethiopia revealed that IPIs have a statistically significant association with the

Table 4. Univariate analysis of factors associated with intestinal parasite infection at Amber Primary School, 2020.

Variables	Category	Result		Univariate analysis	p value	Chi-square
		Positive	Negative	COR (95% CI)		
Sex	Male	44	149	0.661 (0.419–1.042)	0.074	3.211
	Female	59	132	1.00		
Age group in years	5–8	18	47	1.149 (0.531–2.487)	0.725	0.151
	9–12	68	183	1.115 (0.602–2.063)	0.729	
	13–16	17	51	1.00		
Grade level	1–4	71	169	1.470 (0.909–2.378)	0.116	2.528
	5–8	32	112	1.00		
Mother's educational status	Unable to read and write	41	115	1.337 (0.644–2.774)	0.435	4.862
	Elementary school	37	72	1.927 (0.910–4.080)	0.087	
	High school	13	49	0.995 (0.411–2.405)	0.991	
	College and above	12	45	1.00		
Family size	4 and below	27	70	1.00		0.039
	5–7	69	203	0.881 (0.523–1.484)	0.635	
	8 and above	7	8	2.269 (0.750–6.865)	0.147	
Contact with domestic animals	Yes	43	132	0.809 (0.513–1.277)	0.363	0.833
	No	60	149	1.00		
Nail trimming	Yes	37	81	1.00		1.752
	No	66	200	0.722 (0.448–1.165)	0.183	
Shoe wearing habit	Always	49	129	1.00		0.104
	Sometimes	52	147	0.931 (0.590–1.470)	0.760	
	Never	2	5	1.053 (0.198–5.608)	0.952	
Hand washing before eating	Always	79	216	1.00		2.372
	Sometimes	14	49	0.781 (0.409–1.493)	0.455	
	Never	10	16	1.709 (0.744–3.923)	0.206	
Hand washing after defecation	Always	16	50	1.00		0.490
	Sometimes	51	142	1.122 (0.587–2.145)	0.727	
	Never	36	89	1.264 (0.638–2.503)	0.501	

COR: crude odds ratio; CI: confidence interval.

Table 5. Multivariate analysis of factors associated with intestinal parasite infections at Amber Primary School, 2020.

Variables	Category	Result		Multivariate analysis	p value
		Positive	Negative	AOR (95% CI)	
Sex	Male	44	149	0.624 (0.392–0.993)	0.047*
	Female	59	132	1.00	
Grade level	1–4	71	169	1.376 (0.839–2.258)	0.206
	5–8	32	112	1.00	
Mother's educational status	Unable to read and write	41	115	1.489 (0.710–3.122)	0.292
	Elementary school	37	72	2.171 (1.012–4.658)	0.046*
	High school	13	49	1.125 (0.460–2.752)	0.796
	College and above	12	45	1.00	
Family size	4 and below	27	70	1.00	
	5–7	69	203	0.812 (0.464–1.421)	0.466
	8 and above	7	8	1.856 (0.578–5.957)	0.299
Nail trimming	Yes	37	81	1.00	
	No	66	200	0.787 (0.467–1.327)	0.369
Hand washing before eating	Always	79	216	1.00	
	Sometimes	14	49	0.793 (0.395–1.589)	0.513
	Never	10	16	1.501 (0.5598–3.771)	0.387

AOR: adjusted odds ratio; CI: confidence interval.

* $p < .05$.

mother's educational status.²² Another study conducted in Chench town, South Ethiopia demonstrated that IPIs had statistically significant association with the educational status of the household heads, absence of washing facility, home cleanliness, and type of latrine.²⁹

Limitations of the study

The study involved participants from one school only, which compromise generalizability of findings. We have applied direct wet mount to detect intestinal parasites, which might underestimate the prevalence. We are unable to differentiate between *E. histolytica* and *E. dispar* due to inaccessibility of molecular diagnostic tools.

Conclusion and recommendation

The prevalence of at least one intestinal parasite was 26.8% and it is significantly associated with sex of children and their mother's educational status. Appropriate intervention measures targeting school children should be implemented to prevent the burden imposed by IPI and related morbidities. School-based intestinal parasite screening and treatment and improvement of environmental sanitation practice are highly recommended, which can be achieved by the involvement of health care providers, the community, and religious leaders.

Acknowledgements

We authors would like to thank Debre Markos University, data collectors, and study participants.

Authors' contributions

T.G., T.A., and T.D. conceived the study, and were involved in data collection, analysis, and interpretation. Y.A. was involved in drafting of the article. M.T. assessed the quality of the article. All authors reviewed and approved the article.

Availability of data and materials

The datasets used and/or analyzed during this study are available from the corresponding author upon reasonable request

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval for this study was waived (Ref No.: M/L/S/229/02/13) by the Research and Ethics Committee of College of Health Sciences.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The research was funded by Debre Markos University.

Informed consent

Written informed consent was obtained from parents/guardians for children below the age of 12 years and assent was obtained from children aged 12–17 years in addition to informed consent by a parent/legal guardian before data collection. As stated in the national research ethics review guideline, work with children not capable of giving consent requires assent and the consent of their parent or guardian. Consent may only be given by individuals who have reached the legal age of consent (18 years old). The child below the legal age should provide assent in addition to the informed consent by a parent or guardian.³⁰ Full clarification about the aim of the study was made to the authorized person of the school. Stool examination was carried out free of charge. Positives for intestinal parasite were linked to Amber Health Center to have timely treatment without fee.

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Supplemental material

Supplemental material for this article is available online.

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