Research Article
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Prevalence and risk factors of intestinal parasites among primary school children in Shashamane town, southern Ethiopia

Abstract

Background: In spite of mass drug administration, in Ethiopia, a significant number of school children infected had an intestinal parasite infection. Investigating factors associated with the prevalence of intestinal parasite infection among school children is indispensable to design appropriate preventive strategies. This study aimed to assess the prevalence of intestinal parasite infection and associated factors among school children in Melka Essa primary school, Shashamane town South Ethiopia.

Methods: A school–based cross–sectional study was employed in south Ethiopia from June 19–30, 2019. Three hundred thirty–three school children were included using a systematic sampling technique. Data were collected using a structured questionnaire and stool–specimen examination for intestinal parasites. Stool samples were collected and processed by direct wet mount and formol–ether concentration techniques for microscopic detection of intestinal parasites. Descriptive statistics were computed. Binary and multivariable logistic regression analyses were conducted to identify factors associated with intestinal parasites.

Results: The overall prevalence for at least one intestinal parasite infection was 19.7% (95%CI: 15.3–24.5). *Hymenolepsis nana* (36.2%), *Ascaris lumbricoides* (24.1%), *Entamoeba histolytica/dispar* (12.1%), *Giardia lamblia* (12.1%), *Tinea species* (12.1%), and *Enterobius Vermicularis* (3.4%) were identified. Walking with barefoot [AOR=3.63, 95% CI =1.63– 8.07] and having untrimmed fingernails [AOR=1.95, 95% CI=1.05–3.62] were associated with the presence of intestinal parasite infections.

Conclusions: Overall, every fifth of the student was infected by intestinal parasites in the present study. Walking with barefoot and having untrimmed fingernails were independent predictors for intestinal parasite infections. Thus, there is a need for consistent health education related to personal hygiene along with routine mass drug administration in the study area.

Keywords: intestinal parasitic infections, school children, soil–transmitted helminthes, wash, south ethiopia

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Introduction

Intestinal parasitic infections (IPIs) are among the most common infections worldwide and affect the poorest and most deprived communities, where poor hygiene and environmental sanitation are frequent. One or more species of protozoa, trematodes, nematodes, and cestodes are responsible for the diseases caused by intestinal parasitosis.[1] The main species that infect people are the roundworm (*Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*) and the hookworms (*Necator americanus* and *Ancylostoma duodenale*).[2]

Globally, around 3.5 billion people were infected with intestinal parasites and about 12% of the disease burdens caused by intestinal parasites are observed among children.[3,4,5,6] It is also estimated that over 267 million preschool–age children and over 568 million school–age children live in areas where intestinal parasites are intensively transmitted.[4]

The greatest numbers of soil–transmitted helminths (STH) infections occur in tropical and subtropical regions, especially in China, India and Southeast Asia, as well as sub–Saharan Africa.[7] In sub–Saharan African, IPIs caused by pathogenic helminths and protozoan species are considered endemic.[8,9] Different factors, such as geographic and socioeconomic factors, poor sanitary facilities, personal hygienic conditions and above all poverty give the best conditions for the escalation and transmission of IPIs in this region.[3,10–14]

Interestingly, Ethiopia contributes to the highest–burden of IPIs and accounts for 8% of the global STH infections.[8] In the country, IPIs are the second most predominant causes of outpatient morbidity among preschool–age and school–age children.[15] The global estimate showed that school–aged children were highly infected with hookworm, *A. lumbricoides*, *T. trichiura*, and other STH species.[16–18]

Despite efforts to eliminate IPIs in Ethiopia, several studies reported high IPIs.[15,17–21] Recent studies which were conducted in Northwest[22] and North Ethiopia reported IPIs prevalence ranging from 30.8–65.5%.[22,23] As per the available literature, there are limited updated studies in south Ethiopia except that of[24–26] Prevalence of IPI was assessed in Birbir town among primary school students reported 27.1%,[24] in Chencha town, 81.0%,[25] and in Arbaminch–town, Southern Ethiopia 27.7%.[26] This previous study failed to assess the current prevalence of IPI in Shashamane town, the most populated city in Southern Ethiopia. Moreover, after the national school based deworming has been implemented since 2015 and few studies were conducted in South Ethiopia.[24] Therefore, this study aimed to assess the prevalence of intestinal parasitic infection and associated factors among students at Melka Essa primary school, Shashamane town South Ethiopia.

Methods and materials

Study design and setting

A cross–sectional study was conducted from June 19–30, 2019 in Melka Essa primary school, Shashamane town. It is located about 250 km from Addis Ababa, the capital city of Ethiopia. Melka Essa primary school has 1–8th grade students, with a total of 33 sections. The total number of students registered in the academic year was 2,641, of this 1,422 are female and 1,219 are male in the 2019 academic year.

Sample size and sampling technique

A single population proportion formula was used to estimate the sample size (n). Taking 27.1% prevalence (p) of intestinal parasitic infection,[24] 95% confidence level (Z=1.96) and 5% margin of error (d=0.05), the initial sample size was 303. Finally, by adding the possible 10% non–responses, the overall sample size was 333.

Study population and sampling technique

All students found in Melka Essa primary school were the source population and those randomly selected students were considered as our study population. A systematic sampling technique was used to select students. First, a sampling frame was prepared from the student registration books (enrollment list). After calculating, Kth interval (N/n=2641/333) every K (≈8) interval each student was selected until the required sample size was fulfilled. The first students were selected by using the lottery method. Children whose parents did not give consent were excluded.

Data collection

A structured questionnaire was used to collect data from study participants. The questionnaire was prepared in English and then translated into the local language (Afan Oromo) and then back–translated to ensure consistency. Data regarding study participants' hygiene status (fingernail trimmed status) was collected by direct observation.

Stool specimen collection and examination

Three trained data collectors (medical intern students) collect all the necessary background data by using a structured questionnaire. After providing adequate instruction each student was provided with a uniquely labeled stool cup, applicator stick and soft tissue paper (for cleaning) to bring 3gm of fresh stool sample of their own, which was sufficient for the direct wet mount. A temporary microscopy station was set in the Melka Essa primary school compound for this purpose. Direct saline and iodine wet mount preparations were examined within 20 min after collection to intestinal parasites at the school.[24] Also, all standard operating procedures (SOP) were strictly followed during the stool sample examination to ensure the quality of the test results.

Data quality control

In order to improve the quality of data collection tool, a pre–test was done on 10% of the actual sample size. In addition, the data collection tool was tested for internal consistency using Cronbach's alpha test. The resulting Cronbach's Alpha value of 0.813 was obtained. Moreover, stool samples were randomly selected for quality control purposes and examined by experienced laboratory technologists who were blinded to test.

Statistical analysis

Data were entered and analyzed using SPSS version 20.0. Descriptive statistics were calculated. Bivariate logistic regression was used to assess the associations between dependent and independent variables. During bivariate analysis variables that show statistically significant association at p–value ≤ 0. 25 were entered to multivariate logistic regression to identify the independent predictors. Adjusted odds ratios (AOR) with 95% CI were estimated to assess the strength of associations and statistical significance was declared at a p–value < 0.05.

Ethics approval and consent to participate

Ethical approval was obtained from the Madda Walabu University Ethical Review Committee. Official letters of permission were also obtained from Madda Walabu University Goba Referral Hospital Community Based Education Program, Shashamane town education bureau and Melka Essa primary school director. Before the commencement of data collection, parents and legal guardians of the children were adequately informed about the purpose, procedure of the study and the confidentiality of the information they provided. Finally, written consent was considered from parents and legal guardians of children who were willing to take part in the study. Children who had been diagnosed with the intestinal parasites were treated immediately with appropriate drugs for free. Data will be available upon request from the corresponding authors.

Results

Socio–demographic characteristics

Two hundred and ninety–four study participants were included in the present study with a response rate of 88.2%. The mean (standard deviation) age of the study participants was 11.61(2.6). Of the total participants, 153(52%) were males while the remaining 141(48%) were females and three–fifths of the participants were in grade 1–4 (Table 1).

Behavioral and sanitation–related characteristics of the study participants

One hundred and twenty–four (42.2%) of the participants were disposed of their solid waste in the open field. The majority of the respondents (93.5%) had some form of the traditional pit latrine. In this study, one out of three student's fingernails is not trimmed at the time of data collection.

Table 1 Socio–demographic characteristics of school children and their parents at Melka–Essa Primary School, Shashamane town, South Ethiopia, 2019

Variables	Category	Frequency	Percent
Age (years)	6–9	68	23.1
	10–13	152	51.7
	>13	74	25.2
Sex	Male	153	52.0
	Female	141	48.0
Grade	1–4	177	60.2
	5–8	117	39.8
Family size	≤ 5	100	34.0
	>5	194	66.0
Father educational level	Can't read and write	40	13.6
	Read and write	49	16.7
	Primary education	101	34.4
	High school	68	23.1
	Diploma	27	9.2
	Attend Higher education	9	3.1
Mother educational level	Can't read and write	82	27.9
	Read and write	54	18.4
	Primary education	110	37.4
	High school	37	12.6
	Diploma	7	2.4
	Attend Higher education	4	1.4
Father occupation	Merchant	131	44.6
	Government employee	64	21.8
	Farmer	41	13.9
	Other♣	58	19.7
Mother occupation	Merchant	146	49.7
	House Wife	126	42.9
	Government employee	16	5.4
	Other♣♣	6	2.0

♣Self–employed, daily laborer, carpenter, and skilled manual

♣♣Self–employed and daily laborer

Prevalence of intestinal parasitic infection

Of the 294 students, fifty–eight (19.7%) [95%CI: 15.3–24.5] were positive for at least one type of intestinal parasites. Six different types of intestinal parasites species were identified (Table 2). The most prevalent intestinal parasites identified were *Hymenolepsis nana* 21 (36.2%), followed by *Ascaris lumbricoides* 14(24.1%), *Tinea* species 7(12.1%), *Entamoeba histolytica/dispar* 7(12.1%), *Giardia lamblia* 7(12.1%) and *Enterobius vermicularis* 2(3.4%) is the least observed parasite. All are a single infection and there is only one high load of *Hymenolepsis nana* infection (Figure 1). A higher proportion of IPI was recorded for boys (58.6%), and the age group 10–12 years (41.4%).

Factors associated with intestinal parasite infection

In the adjusted model, children who had untrimmed fingers and who walk with bare foot had higher odds of IPIs. The prevalence of intestinal parasitic infections was 1.95 times more likely to be higher among children who had untrimmed fingernails [AOR=1.95, 95% CI=1.05–3.62]. Also, the probability of intestinal parasitic infections was 3.63 times more likely to be higher among children who frequently walking with barefoot [AOR=3.63, 95% CI=1.63–8.07]. To check the correctness of the final model, the Hosmer and Lemeshow test for the overall goodness of fit was used, with a value of 0.352 that is insignificant, which means the final model was correct (Table 3).

Table 2 Type of intestinal parasite by species among primary school children at Melka Essa primary school in Shashamene town, South Ethiopia, 2019

Variables	Category	Frequency	Percent	95%CI
Presence of intestinal parasite	Yes	58	19.7	15.3–24.5
	No	236	80.3	75.5–84.7
Type of intestinal parasite identified (n=58)	*Hymenolepsis nana (Ce)*	21	36.2	24.1–48.3
	Ascaris lumbricoides (Ne)	14	24.1	13.8–34.5
	Entamoeba histolytica/dispar (Pr)	7	12.1	3.4–20.7
	Giardia lamblia (Pr)	7	12.1	5.2–20.7
	Tinea species (Ce)	7	12.1	5.2–20.7
	Enterobius Vermicularis(Ne)	2	3.4	0.0–8.6

Ce, Cestodes; Ne, Nematodes; Pr, Protozoa

Table 3 The association between intestinal parasite infection and explanatory variables among students at Melka Essa primary school in Shashamane town, South Ethiopia, 2019**

Variables	Category	Presence of intestinal parasite		COR(95%CI)	p–value	AOR(95%CI)
		Yes (n=58)	No (n=236)			
Sex	Male	34	119	1.39(0.77–2.49)	0.26	
	Female	24	117	1		
Age	6–9	13	55	0.80(0.25–2.57)	0.83	0.90(0.27–3.07)
	10–12	24	86	0.94(0.31–2.83)		1.13(0.36–3.58)
	13–15	16	78	0.69(0.22–2.16)		0.82(0.25–2.67)
	>15	5	17	1		1
Grade	1–4	35	142	1.01(0.56–1.81)	0.98	
	5–8	23	94	1		
Mother Educational status	Can't read and write	17	65	1.09(0.57–2.05)	0.78	
	Had formal education	41	171	1		
Father educational status	Can't read and write	8	32	1.02(0.44–2.34)	0.96	
	Had formal education	50	204	1		
Mother occupational status	Housewife	25	101	1.01(0.56–1.80)	0.96	
	Employee	33	135	1		
Father occupation	Farmer	9	32	1.19(0.52–2.72)	0.90	
	Government employee	13	51	1.08(0.53–2.20)		
	Merchant and other	36	153	1		
Waste disposal	Open field	24	100	0.96(0.53–1.71)	0.89	
	Burial	34	136	1		
Type of latrine	Traditional pit latrine	56	219	2.17(0.48–9.68)	0.29	
	VIP	2	17	1		
Presence hand washing facility at the doorstep of the latrine (n=292) (Self–report)	Yes	23	80	1.26(0.70–2.28)	0.43	
	No	35	154	1		

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Table Continued...

Variables	Category	Presence of intestinal parasite		COR(95%CI)	p–value	AOR(95%CI)
		Yes (n=58)	No (n=236)			
Do you wash your hands regularly before the meal?	Yes	43	166	1.20(0.63–2.31)	0.56	
	No	15	70	1		
Fingernail trimmed at the time of data collection	Trimmed	33	172	1	0.01	1
	Not trimmed	25	64	2.03(1.12–3.68)*		1.95(1.05–3.62)**
Raised dog or cat at home	Yes	24	83	1.30(0.72–2.34)	0.37	
	No	34	153	1		
Livestock at home	Yes	26	90	1.31(0.73–2.35)	0.35	
	No	32	146	1		
Deworming history in the last three months?	Yes	8	47	0.64(0.28–1.44)	0.28	
	No	50	189	1		
Do you frequently eat raw/ unwashed vegetables?	Yes	37	115	1.85(1.02–3.35)*	0.04	1.56(0.84–2.88)
	No	21	121	1		1
Walking within a barefoot	Yes	14	17	4.09(1.88–8.92)*	0.00	3.63(1.63–8.07)**
	No	44	219	1		1

**Hosmer and Lemeshow Test (p–value=0.352)

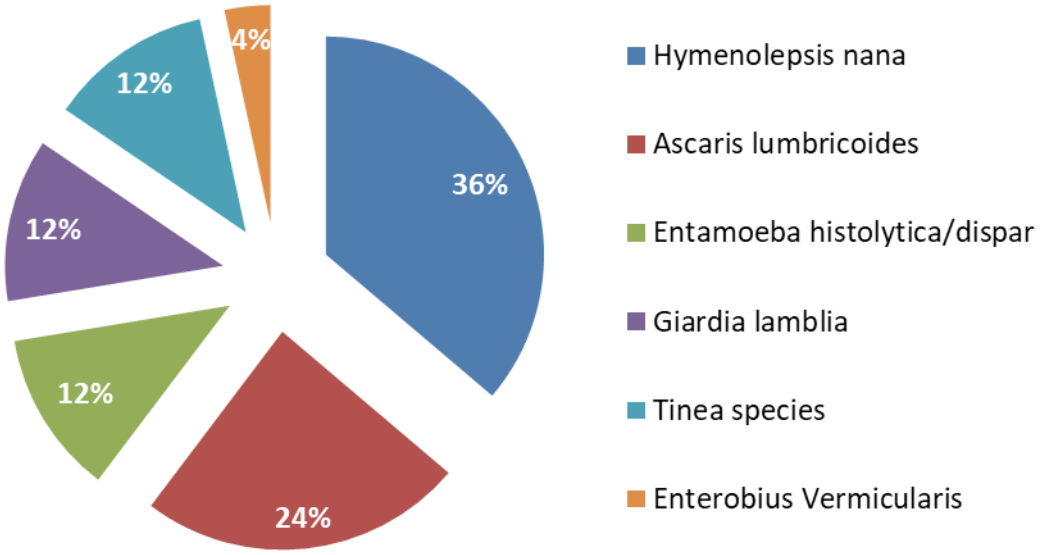

Figure 1 Type of intestinal parasite at Melka Essa primary school, South Ethiopia, 2019.

Discussion

This study attempted to assess the prevalence of IPIs among school children in southern Ethiopia. The results of this study showed the occurrence of IPIs in school children was prevalent and a major public health concern. Further, walking with barefoot and untrimmed fingernails was significantly associated with the presence of IPIs.

The prevalence of IPI was 19.7% (95%CI: 15.3–24.5). Meaning, nearly every fifth of the students was infected by intestinal parasites which were almost comparable to the prevalence documented in Southern Ethiopia, Arbaminch town[26] and Birbir town.[24] This could be attributed to poor sanitation facility and personal hygiene practice of the students, as 6.5% only had VIP latrine, 42.2% disposed of wastes in open filed and 28.9% of students reported they do not wash their hands regularly before the meal. This finding is similar to other studies from northwest Ethiopia (22.7%),[27] 25.8%,[28] and Butajira town (23.3%).[29] However, the result of this study was much lower than previous findings reported in Bahir Dar (65.5%),[23] Chencha town (southern Ethiopia) (81.0%),[25] in north Ethiopia (Adwa town) 69%,[30] northern Gondar 66.7%,[31] and East Gojjam (northwest Ethiopia) 84.3%.[32] This can be due to study period difference; the Ethiopian national mass drug administration program has been implemented since 2015 and efforts have been made in order to improve Water, Sanitation and Hygiene (WASH). Hence, studies conducted before this period may detect high prevalence of intestinal parasite infections

among school children. Also, the geographical variation might confer the discrepancy. Higher prevalence of IPIs than the present study were also reported from other low–income settings, such as Nigeria (67.4%),[33] Sudan (90.4%),[34] Yemen (90%),[35] Rwanda (50%)[36] and Burkina Faso (84.7%).[37]

Hymenolepsis nana was the first most frequently encountered parasite in this study with a prevalence rate of 36.2%. This prevalence was higher than the prevalence obtained in northwest Ethiopia 14%,[22] southern Ethiopia 4.2%,[26] Birbir town 1.7%,[24] and northwest Ethiopia 7%.[28] Various reasons were explained this variation; such as geographical settings difference, sanitation facility coverage, accessibility of safe water, and personal hygiene dissimilarity.[22,24,28] *Ascaris lumbricoides* was the second predominant intestinal helminths with a prevalence of 24.1%. A higher prevalence of *A. lumbricoides* (33.3–78%) was reported at different geographical settings of Ethiopia.[22,25,28,38]

In the present study, children who had untrimmed fingernails were almost two times more likely to be infected with intestinal parasitic infections. This is consistent with a study report from Bahir Dar, which reported children with unclean fingernail were 3.68 times at higher risk.[23] Also, studies at different geographical settings of Ethiopia indicated that cleanness of fingernail and trimming were significantly associated with intestinal parasitic infections.[26,39] This is because the helminths might be confined into the nail of the students and may cause infections as they ingest food; hands and fingers of students might be easily contaminated with soil that contains cyst and eggs of parasitic organisms. However, these factors were not associated with intestinal parasitic infections in the study conducted by Alemu et al.[24]

The risks of being infected by IPIs were increased by nearly four–folds among students who frequently walking with barefoot as compared with students regularly used protective shoes. Comparable findings of an association between intestinal parasitic infection and shoe wearing the habit of students were reported from studies conducted elsewhere in Ethiopia.[21,23,40] Not surprisingly a lack of protective shoe is known risk factors to increase the chance of hookworm and other infections.

The study has some limitations: Firstly, social–desirability bias was likely for self–reported responses. Second, due to resource constraints, we did not perform molecular techniques like PCR to identify and differentiate *E. histolytica* from *E. dispar*. Third, the study shares all the limitations of the cross–sectional study design.

Conclusion

Overall, every fifth of the student was infected by intestinal parasites, which signify a common health problem among school children. *H.nana, A.lumbricoides, E.histolytica/dispar , G.lamblia, Tinea species*, and *E.Vermicularis* were identified. Untrimmed fingernails and walking within barefoot were the potential predictors of intestinal parasitic infections. Thus, there is a need for consistent health education related to personal hygiene along with routine mass drug administration in the study area.

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Conflicts of interest

The authors declare that there was no conflict of interest.

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