

Prevalence and Associated Factors of Intestinal Helminths Among Kindergarten Children in Gondar Town, Northwest Ethiopia

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Abiy Ayele¹
 Yalewayker Tegegne²
 Adane Derso²
 Tegegne Eshetu²
 Ayalew Jejaw Zeleke²

¹Department of Immunology and Molecular Biology, School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia;

²Department of Medical Parasitology, School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Background: Intestinal parasitic infections (IPIs) are small organisms that infect the gastrointestinal tract of human beings. Causes malnutrition, iron deficiency anemia, impairment of physical and mental development in children. The aim of this study was to determine the prevalence of intestinal helminthiasis and associated factors among Kindergarten (KG) children in Gondar Town, northwest Ethiopia.

Methods: Institution-based cross-sectional study was conducted on 390 Kindergarten children in Gondar town, Northwest, Ethiopia from March to May 2019. Study subjects were selected using systematic random sampling method. Data were gathered through direct interview by using a pretested questionnaire. Stool specimens were collected and examined using Kato Katz technique. Chi square was used to assess the association between variables and *p*-value less than 0.05 was taken as a statistical significance.

Results: The overall prevalence of intestinal helminthiasis was 16.7%, while those of participants infected by soil-transmitted helminths (STHs) and intestinal Schistosomiasis were 13.8% and 5.9%, respectively. *Ascaris lumbricoides* was the predominant STHs (9%) followed by *Trichuris trichiura* (2.3%) and hookworm (1.5%). Light infection was observed in almost all of the infected study participants. Intestinal helminthiasis was found to be significantly associated with age, KG level of children, maternal occupation, and educational status of parents.

Conclusion: A significant number of children were infected by intestinal parasites in the study area. *A. lumbricoides* and intestinal Schistosomiasis were the most predominant of the isolated parasites.

Keywords: soil-transmitted helminths, intestinal schistosomiasis, preschool children

Introduction

Intestinal parasitic infections (IPIs) are small organisms that infect the gastrointestinal tract of human beings. They are more prevalent among children compared with the general population. About 12% of the global disease burden caused by intestinal parasites is observed among children aged 4 to 6 years in developing countries.¹ Preschool children in Kindergartens are one of the groups of the people at high risk for IPIs.²

Currently, the big three soil-transmitted helminths (*A. lumbricoides*, *T. trichiura* and hookworm) are the leading cause of intestinal parasitosis. They are linked with significant figures of morbidity and mortality in the world.^{3,4} However, the incidence and prevalence of such infections may vary within and across countries due

Correspondence: Adane Derso
 College of Medicine and Health Sciences,
 University of Gondar, Gondar, Ethiopia
 Tel +251930716000
 Email adanedm77@gmail.com

to several factors.⁵ According to the 2017 WHO report, the estimated number of people known to be infected globally with *A. lumbricoides*, *T. trichuria*, and hookworm was 820,440, 460 million, respectively.⁶ All of these parasites most commonly infect children and adolescents.^{7,8}

The adult stage of STHs colonizes the intestine, whereas *S. mansoni* resides in the mesenteric blood vessels. They all produce thousands of eggs to the external environment every day. In places of poor sanitation, the eggs/larvae contaminate the soil and parasitize humans when ingested with foods or penetrate the skin. The worms do not multiply in the human host, and their intensity increases only as a result of re-infections.⁶

Poor hygiene, low immune status, overcrowding, close contact with soil and to each other, lack of latrine, and low provision of water in schools are some of the factors that put school-age children at high risk for intestinal parasitic infection.⁹

The prevention and control of STH and *S. mansoni* could be based on avoiding the contamination of food or water with fecal material.¹⁰ Health promotion and education aimed at improving personal hygiene and encouraging hand washing with soap and water, proper latrine utilization and food handling are also effective control activities for the reduction of person-to-person transmissions.¹¹ Moreover, community-based mass deworming program, particularly among preschool children through annual or bi-annual distribution of a single dose of a broad spectrum benzimidazole drugs is the current advocated and practiced control strategy.¹²

Children are sadly reported to be at an increased risk for severe infections and the morbidity associated with intestinal parasitic infections.¹³ The adverse effects of intestinal parasites among preschool children are diverse and alarming. They have detrimental impacts on the survival, appetite, growth and physical fitness, school attendance and cognitive performance of children.¹⁴ For this reason, regular parasitological surveillance may have a crucial role in reducing a wide range of health consequences by these infections.

Though previous studies conducted in Ethiopia focusing on distribution of different intestinal parasites on various study groups such as school children and other study groups in hospitals, refugees, and the community, the prevalence of STH and intestinal schistosomiasis was not well addressed indifferent parts of Ethiopia including our study area. Therefore, the aim of this study was to determine the prevalence and associated factors of soil-

transmitted helminths and *S. mansoni* infection among Kindergarten children in Gondar town, North West Ethiopia.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from University of Gondar School of Biomedical and Laboratory Science (Ref.No. SBMLS/1021/11) ethical committee and study was conducted in accordance with the Declaration of Helsinki. The kindergarten teachers and parents were informed about the purpose and procedures of the study. Written informed consent was obtained from the parents or legal guardian. All positive participants were treated according to the guidelines of the National Helminths Control Program of Ethiopia by referring to them to the nearby health center.

Materials and Methods

Study Setting

The study was conducted among kindergarten children in Gondar town of Central Gondar zone of the Amhara region in Northwestern Ethiopia. Gondar town is located 738km Northwest of Addis Ababa (the capital city of Ethiopia). Gondar is north of Lake Tana and southwest of the Simien Mountain. It has latitude of 12°36'N 37°28'E with an elevation of 2133 meters above sea level. Based on the 2007 census result, the town has a projected total population of 323,900.¹⁵

Study Design, Period, and Sampling Technique

Institution-based cross-sectional study was conducted from March to May 2019. The sample size was determined by using single population proportion formula. By considering prevalence of IPIs from previous study ($p=15.5\%$).¹⁶ 95% confidence interval ($Z=1.96$) and 5% marginal error ($d=0.05$) and design effect of 2. Then the sample size was calculated as $n = [Z - a/2]^2 P (1-p)/d^2$, where: n = sample size, P = proportion problem in the study area, $Z - a/2$ = CI of 95%, d = Marginal error to be tolerated. Sample size was calculated to be 402.

The study was conducted in both private and governmental schools. There were about 75 (30 private and 45 governmental) Kindergarten schools in the Town. During the study period, the total number of children attending the Kindergartens in the town was 20,000. Through simple random sampling method, three governmental and five

private schools were selected proportional to the total number of students. The students were stratified according to their Kindergarten (KG) grade level, Children whose age 4, 5 and 6 years were allocated in KG grade level 1, 2 and 3, respectively. Then, quota sampling was used to each grade based on the number of students. Then the number of the study participants in each grade was determined by using systematic random sampling technique using their class rosters as sampling frame.

Inclusion and Exclusion Criteria

All children who had no history of anti-helminthic drugs in the last 1 month before screening were included in the study. While, those school children who were not voluntary to give stool samples were excluded in the study.

Data Collection and Processing

Questionnaire Survey

Socio-demographic characteristics and associated factors were collected by face-to-face interview method using pre-tested structured questionnaire. English version of the questionnaire was translated to a local language “Amharic” version (see [Supplementary Materials](#)). Comparisons were made on the consistency of the two versions. After onsite training given for data collectors. A pretest was conducted among five percent of the total sample size that was selected randomly from all sections on which cross-sectional study was conducted. The interview included information such as age, marital status of mother, mother and father educational status, mother and father occupation.

Parasitological Analysis

A labeled, clean, leak proof empty container with unique identification (ID) numbers was distributed to the children and 3 gram of stool samples was collected. The samples were transported and processed at University of Gondar, School of Biomedical and Laboratory Science Medical Parasitology Laboratory Room. Each stool sample was examined by using Kato Katz technique. Hook worm ova detection was performed by examination of the Kato Katz slide within one hour of stool collection and its preparation. Specially, for the identification of *S. mansoni* and other helminths ova the prepared slides was left for 24 hours for better clearing and easy visualization of eggs. Infection intensity of the STHs and *S. mansoni* was estimated by multiplying the total number of eggs counted by 24, which gives as the eggs per gram (epg) of stool.

Besides, the species-specific classes of infection intensity with *S. mansoni* and STH were classified as light, moderate and heavy as per the threshold set by WHO as Intensity of *S. mansoni* was classified into: light infection (1–99epg), moderate (100–399 epg) and heavy (greater than 400epg). Likewise, the classification for *A. lumbricoides*: light infection (1–4999epg), moderate (5000–49999epg) and heavy (greater than 50,000epg). Intensity of *T. trichiura*: light infection (1–999epg), moderate (1000–9999epg) and heavy (greater than 10,000epg). Classification of hookworm is: light infection (1–1999epg), moderate (2000–3999 epg) and heavy (greater than 4000epg).¹⁷

Data Management and Analysis

The obtained data was edited and analyzed by statistical package for social science (SPSS) software version 20.¹⁸ Descriptive statistics like frequency, mean and percentage was calculated to describe the study population characteristics. A chi square was used to assess the association between variables. The strength of associations was measured by 95% confidence interval and *p* value less than 0.05 was taken as a statistical significance. Compiled results were presented in the form of text, tables or graphs.

Results

Socio-Demographic Characteristics

A total of 390 Kindergarten school children aged 4 to 6 years were included in the study. The male to female ratio was 1:1. The majority were 5 years old. The other socio-demographic characteristics of the study participants are presented ([Table 1](#)).

Prevalence of Intestinal Helminths Infections

The overall prevalence of intestinal helminthiasis was 16.7%. The prevalence of STHs was found to be 13.8%. *A. lumbricoides*, the most common STHs isolated was 9.0%, followed by *T. trichiura* (2.3%), and hookworm (1.5%). *Schistosoma mansoni* and *H.nana* were the other types of intestinal helminths whose detection rate was 23 (5.9%) and 6 (1.5%), respectively. The distribution of intestinal helminths among the study participants is shown ([Figure 1](#)).

Intensity of STHs and *S. mansoni* Infection

Almost all of the 35 Kindergarten children who were positive for *A. lumbricoides* had light infection, while

Table 1 Socio-Demographic Characteristics of Kindergarten Children in Gondar Town, Northwest Ethiopia, 2019

Variables		Frequency	Percentage (%)
Grade	KG1	110	28.2
	KG2	168	43.1
	KG3	112	28.7
Marital status of mother	Married	351	90
	Single	1	0.3
	Divorced	31	7.9
	Others	7	1.8
Mother educational level	Illiterate	36	9.2
	Read and write	92	23.6
	Primary	43	11
	Secondary	63	16.2
	College	156	40.0
Father educational level	Illiterate	22	5.6
	Read and Write	41	10.5
	Primary	55	14.1
	Secondary	80	20.5
	College	192	49.2
Mothers occupation	Farmer	33	8.5
	Merchant	80	20.5
	Government employee	136	34.9
	Other	141	36
Fathers occupation	Farmer	27	6.9
	Merchant	103	26.4
	Government employee	200	51.3
	Other	57	14.4

only one 1 (2.8%) faced a moderate infection. The intensity of infection with *T. trichiura*, hookworm, and *S. mansoni* was light among all infected study participants (Table 2).

Factors Associated with the Prevalence of Intestinal Helminths

In this study, the prevalence of intestinal helminthiasis was significantly associated with age, KG level, maternal education and occupation and paternal education (*P* value <0.05), but not with sex of the participants (Table 3).

Discussion

Studies that indicate the burden of STH and other intestinal parasites in different areas are crucial for identifying communities at high-risk for parasitic infections and for

formulating suitable prevention and control measures. The results of the current study showed the existence of intestinal helminths infections among Kindergarten children in Gondar town, northwest Ethiopia.

In this study, the overall prevalence of intestinal helminthiasis among Kindergarten children was 16.7%. This result was lower than findings of similar studies conducted in other parts of Ethiopia, such as Mekele (18.8%),¹⁹ Jimma (46.6%),²⁰ and Arbaminch (27.7%),²¹ and Yadot in Bale zone (21.9%).²² Similarly, the present finding was lower than prevalence study in Nigeria (30.0%).²³ On the other hand, it is higher than a study conducted in Iran (7.1%).²⁴ The differences in the prevalence of IPIs among different studies could be explained by variations in geography, households socio-economic status, water supply, environmental sanitation, study periods, implementation of prevention and control measures and also it might be laboratory methods used.

The present study showed that *A. lumbricoides* and *S. mansoni* were found to be the most dominant intestinal parasites with 9% and 5.9%, respectively. This predominance was consistent with a previous study conducted in a nearby village in Chuait, Dembia district in which *A. lumbricoides* and *S. mansoni* were the most frequently detected with parasites.¹⁶ The reason behind the high prevalence of *A. lumbricoides* both in the current and previous studies could be related to the hard nature of the egg to resist adverse environmental conditions and this can contribute to the easy transmission of this parasitic infection. The current study also presented that a significant number of pre-school children were positive for *S. mansoni* infection. This could be unusual report since most of us believe that they usually spend their time at home a part from kindergarten school. However, many people in the town are using several rivers for taking bathes and washing of their clothes.²⁵ In connection to this, children frequently go to the river with their parents. The children are playing using water from the river in order to spend their time until their parents finish their work. As a result, they may get infected by cercarial form of the parasite from the water surface.

The prevalence of hookworm and *H. nana* infections were low in this study and are in agreement with findings of studies conducted in Tigray the northern part of the country,¹⁹ and Jimma in southern Ethiopia.²⁰ In the current study, the 2.3% prevalence of *T. trichiura* was lower than the report 38.9% conducted from Jimma.²⁰ The variation may be related to

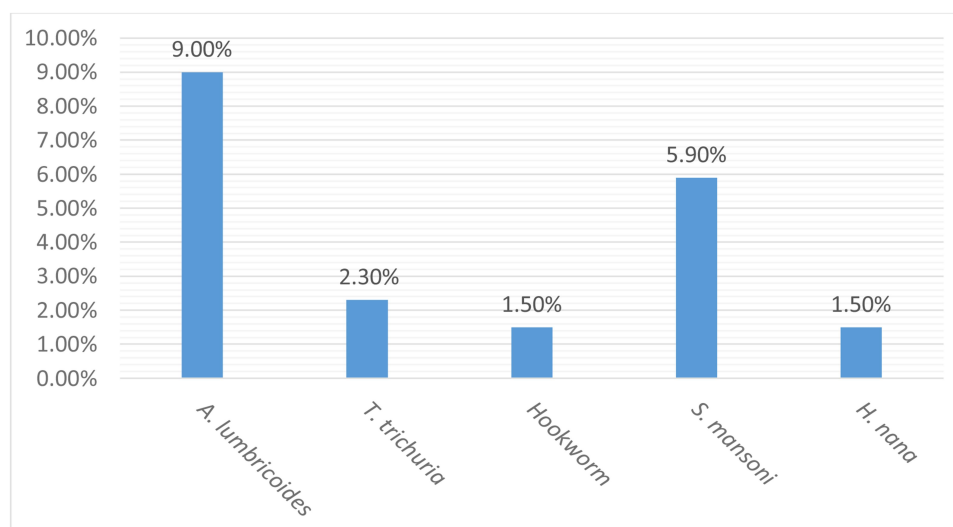


Figure 1 Prevalence of intestinal parasitic infection among kindergarten children in Gondar town, Northwest Ethiopia, 2019.

differences in study areas, that might be related with temperature difference and characteristics of the soil which aids for maturation and easily transmission of infective stage of the parasites, crowdedness and provision of water in the school, number of households, socioeconomic status, and study periods.

The intensity of intestinal helminthiasis in the current study was generally light. Only one child with *A. lumbricoides* experienced a moderate infection. This is in agreement with the result of a study conducted in Chuait, Dembia district.¹⁶ All hookworm, *T. trichiura*, and *S. mansoni* positive study participants were grouped under the light infection category. However, no heavy infection was detected in any of the study participants. That might be linked with the age (≤ 6 years) of the participants. In other words, children whose age less than six are less likely to be exposed to the soil or other risky behaviors to catch intestinal parasites.²⁶

Table 2 Intensity of Infection in Kindergarten School Children with STH and *S. mansoni* Infection in Gondar Town, Northwest Ethiopia, 2019

Type of Parasites	Class of Infection Intensity			
	Light	Moderate	Heavy	Total
<i>A. lumbricoides</i>	34 (95.45%)	1 (2.8%)	0	35 (100%)
<i>T. trichiura</i>	9 (100%)	0	0	9 (100%)
Hookworm	6 (100%)	0	0	6 (100%)
<i>S. mansoni</i>	23 (100%)	0	0	23 (100%)

This study also investigated and determined several factors associated with intestinal helminthiasis. Accordingly, age, Kindergarten (KG) level, mothers' education and occupation, and fathers' education were significantly associated with intestinal parasitosis. The prevalence of intestinal helminthiasis among the Kindergarten children was significantly higher among the age of 6 followed by 5 years. This finding is supported by that of a study conducted in Mekelle.¹⁹ This is possibly as a result of more exposure of the children to the parasites as their age increased. In the study, sex, and parental marital status did not show any significant association with the prevalence of intestinal helminthic infections. The rate of infection was also higher among children whose mothers' were illiterate than any other categories. This shows the role of education in preventing IPIs. Besides, personal hygiene and awareness about the transmission routes of intestinal parasites require literacy.^{21,27,28}

Limitations of the Study

The infection intensity of the common intestinal helminthiasis was determined by the examination of a single stool sample of each participant. That might have affected the prevalence and the accuracy of the egg count of the parasites. Thus, the findings should be interpreted with that limitation in mind.

Conclusion

The present study showed that a significant number of Kindergarten children were infected by intestinal parasites. *A. lumbricoides* and Schistosomiasis were the most

Table 3 Factor Associated with the Prevalence of Intestinal Helminthiasis Among Kindergarten Children in Gondar Town, Northwest Ethiopia, 2019

Variables		Prevalence of Intestinal Helminthiasis			Chi Square	p-value
		Yes, n (%)	No, n (%)	Total		
Sex	Male	31 (15.9)	164 (84.1)	195	0.166	0.684
	Female	34 (17.4)	161 (82.6)	195		
Age in years	4	7 (6.8)	96 (93.2)	103	18.5	0.000
	5	25 (14.8)	144 (85.2)	169		
	6	33 (28)	85 (72)	118		
Grade	KG1	9 (8.2)	101 (91.8)	110	22.35	0.000
	KG2	22 (13.1)	146 (86.9)	168		
	KG3	34 (30.4)	78 (69.6)	112		
Maternal education	Illiterate	26 (72.2)	10 (27.8)	36	94.32	0.000
	Read & write	17 (18.5)	75 (81.5)	92		
	Primary	6 (14%)	37 (86)	43		
	Secondary	4 (6.3)	59 (93.7)	63		
	College	12 (7.7)	144 (92.3)	156		
Maternal occupation	Farmer	17 (51.5)	16 (48.5)	33	36.19	0.000
	Merchant	10 (12.5)	70 (87.5)	80		
	Employ	12 (8.8)	124 (91.2)	136		
	Others	26 (18.4)	115 (81.6)	141		
Father education	Illiterate	13 (59.1)	9 (40.9)	22	35.38	0.000
	Read & write	10 (24.4)	31 (75.6)	41		
	Primary	10 (18.2)	45 (81.8)	55		
	Secondary	11 (13.8)	69 (86.2)	80		

predominant of the isolated parasites. Age, KG level, and parental education were significantly associated with the prevalence of intestinal helminthiasis among Kindergarten children. Therefore, it is advisable to design and implement strategies that can control the burden of such infections among Kindergarten children.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

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Author Contributions

All authors made significant contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it

critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of this research work.

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Disclosure

The authors report no conflicts of interest in this work.

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