

Prevalence and associated risk factors of gastrointestinal helminth infection among primary schoolchildren in Dembi district, southwest Ethiopia

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Abstract

Background: Gastrointestinal helminths (GIH) are widespread in developing countries including Ethiopia. The prevalence and distribution of GIH infection in Ethiopia varies from place to place due to different exposing risk factors. This study aimed to identify the prevalence and associated factors of GIH infection among primary school children in Dembi district, southwest Ethiopia, where data for helminths infections are previously unpublished.

Methods: A cross-sectional study involving 291 school children in Dembi district were included. Fresh stool samples were collected from each student and examined by direct wet mount using both normal saline and Lugol's iodine preparation and concentration techniques using salt and formol-ether solutions. Questioners and observation were also used to identify socio-demographic and associated risk factors. Data were analyzed using SPSS 20.0 statistical software. p -value <0.05 were considered significant.

Results: Six parasite species of gastrointestinal helminth with an overall prevalence of 30.9% were identified. The predominant parasites were found soil transmitted helminth (STH) type including *Ascaris lumbricoides* (43.3%), hookworm (26.7%), *Trichuris trichiura* (8.9%) and *Strongliodes stercoralis* (3.3%). *Teania species* (6.7%) and *Hymanolepis nana* (3.3%) were also the gastrointestinal parasites detected from the stool samples. The highest prevalence of GIH infection has been observed in the age of 5-8 years children (36.7%) followed by 9-12 (33.3%) and ≥ 13 (30.0%) years. Sex, age, source of water supply and latrine usage has a significant association with GIH infection. Male (37.9%) students were two times more likely to have parasite infection (COR= 2.0, 95% CI= 1.17-3.22, $p=0.011$) than female (24%) students. Comparing age groups, 5-8 years were more likely to have higher parasite infection (COR=1.23, 95% CI=0.233-0.797, $p=0.007$) than older age groups (≥ 13 years). Those students used stream as a source of water supply and latrine sometimes were also 1.4 ($p=0.001$) and 2.7 ($p=0.001$) times more likely to have helminthic infection than students used pipe water and latrine, respectively.

Conclusions: The results of this study showed that GIH infection are important public health problem among primary school children in Dembi district which needs an integrated health control program including periodic de-worming, improving sanitation and safe water provision.

Background

Parasitic helminths are multi-cellular eukaryotic invertebrates with tube-like or flattened bodies which exhibit bilateral symmetry. The major groups of parasitic helminths include nematodes and flatworms (tapeworms and flukes). The most commonly known helminthic worms are roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*) and hookworms (*Ancylostoma duodenale* and *Necator americanus*), which is collectively called soil-transmitted helminths (STHs) [1]. Adult hookworm inhabit the upper part of the human small intestine, while *Ascaris lumbricoides* (*A. lumbricoides*) and *Trichuris trichiura* (*T. trichiura*) live in small intestine and large intestine of human gastrointestinal tracts,

respectively [2]. The parasitic worm eggs are produced in the digestive tract and expelled to the environment with the host's faeces [1]. After a period of maturation in the environment, the parasite eggs hatch as infective larvae in the soil (hookworms) or after ingestion in the intestinal tract (*A. lumbricoides* and *T. trichiura*) [1].

The STHs are widely distributed throughout the tropics and subtropics due to favorable climatic conditions as an important factor for their existence and infection [2]. For instance, adequate moisture and warm temperature are an essential environmental for larval development in the soil [3]. Poverty, inadequate water supply, sanitation and poor personal hygiene (especially shoe wearing and hand washing) were also previously reported important epidemiological factor for STHs [1, 4].

Soil-transmitted helminth infections have profound effect on the health of growing children including stunted growth, intellectual retardation, anemia and poor school attendance [5]. These problems are significant in Sub-Saharan Africa (SSA) [4]. Ethiopia is estimated to have the second (26 out of 173 million), third (11 out of 198 million) and fourth highest (21 out of 162 million) burden of ascariasis, hookworm and trichuriasis diseases among SSA countries, respectively [4, 6]. In terms of national STH prevalence rate in Ethiopia, *A. lumbricoides*, *T. trichiura* and hookworm accounted 37, 30 and 16%, respectively [7].

Although several studies have been conducted on the distribution and prevalence of gastrointestinal parasites in Ethiopia [5, 8-13], there are still several localities for which epidemiological information is not yet available [14]. This study was aimed to assess the prevalence and risk factors of GIH infection among primary school children of Dembi district, southwest Ethiopia, where data is limited about helminthes infection.

Methods

Study area and period

The study was carried out among three primary school children in Dembi district from December 2014 to May 2015. The district is located 430 km from Addis Ababa and situated between 8°4'0"–8°5'30"N latitude and 36°27'30"–36°28'30"E longitude in Ilu Abba Bora zone, Oromia regional state southwest Ethiopia. The district elevation is also between 1701 and 1827 meters above sea level.

The area annual rain fall ranges from 500–1000 mm, while the minimum and maximum temperature ranged from 15–19°C and 23–25°C, respectively. The main water supply in the district is streams and rivers and in some areas pipe borne supply. In Dembi district, there is only one health center, one private clinic and three primary schools namely Kambo, Tululami and Dembi.

Study population and subject selection

A cross-sectional study was carried out among primary school children of Dembi district. The year 2015 updated list of Kambo, Tululami and Dembi primary schools were the target population of this study. Among 545 male and 655 female students in the three Dembi district schools, a minimum sample size was selected using an appropriate sampling fraction method (Eq. 1).

$$S = \frac{x^2 NP(1-P)}{d^2(N-1)+x^2P(1-P)} \quad (1)$$

Where S is the required sample size, x (1.96) is the standard deviation at 95% confidence interval, N is the total population size, P is the estimated prevalence (50%) and d is the allowed relative error (0.05) [15]. The minimum sample size after calculation was 291 from the three primary schools including 133, 91 and 67 students from Kambo, Tululami and Dembi schools, respectively.

Data collection and parasitological examination

In this study, the effect of shoe wearing habits, finger nail statuses, hand washing habits, age and sex as independent variable on the prevalence of GIH infection as dependent variable were considered.

Questionnaire was used to gather information on socio-demographic and sanitary facilities of students. The study participants were also examined physically for the presence or absence of dirt materials in their fingernails. At the time of the study, the investigator explained about the purpose of the study (students, school administrators and teachers) and asked school children to complete questionnaires that were prepared based on common risk factors of GIH infection with the help of their teachers.

After the investigator also demonstrated the school children how to collect the sample and handle the samples, they were given a sterile wide mouth plastic containers with screw caps having the appropriate information and identification number. A wooden applicator was also provided to each student. Stool samples for parasitological examination were collected early in the morning before bathing or defecation. In case, if a student couldn't able to collect the morning stool sample by themselves, they were informed to get help from their mothers/guardians. Stool specimens were transported to the laboratory using ice boxes. These specimens were examined by direct wet mount, Lugol's iodine, and formol-ether sedimentation techniques for the presence of intestinal parasites. The samples were first scanned with low power objective (10x) microscopic lens and then switched to 40x objective lens for detail parasitic morphology examination. All specimens were scanned by single investigator to avoid inter-observer error.

Data analysis

Data entered into excel and analyzed by using statistical package for social scientists (SPSS) window version 20.0 software. Association of risk factors with GIH parasites was analyzed by using binary logistic regression. Logistic regression model was generated by inclusion of significant independent predictors (socio-demographics, hygienic habits, and others) at the univariate level against the dependent variable (intestinal parasitic infections). Descriptive statistics was also used. The p -value < 0.05 was considered to be statistically significant.

Results

Among 1200 total students in the three primary schools in Dembi district, 145 (49.8%) male and 146 (50.20) female students were included in the study (Table 1). A significant ($p=0.011$) statistical difference were observed in sex for parasitic infection. Male students (37.9%) found to be 2.0 times more likely at risk (COR=2.0, 95% CI=1.17 3.22) than female students (24.0%).

The age composition of the study participants were ranged from 5 17 years. The majority (41.2%) of the participants were at the age of 13 years, however, the percentage of parasitic infection was found relatively low (22.5%). Age group 5 8 years were found to be significantly ($p=0.007$) at higher risk (1.2 times) with parasitic infection than higher age group (≥ 13 years).

Among the total of 291 participants, 90 (30.9%) participants have been found harboring at least one helminth species (Table 2). Except 7.8% patients (double infection), most (92.2%) infections were identified as single infection type (Table 2). A total of six helminths parasitic species were identified including *Ascaris lumbricoides*, hookworm, *Strongliodes stercoralis*, *Trichuris trichiura*, *Hymenolepis nana*, and *Teania species* (Table 2). The predominant species were found to be *Ascaris lumbricoides* (43.3%) and hookworm (26.7%) followed by *Trichuris trichiura* (8.9%) and *Teania species* (6.7%).

Except *Strongliodes stercoralis* and *Teania species*, females were infected by three parasitic worms. However, the six parasitic worms were identified in male participants with higher infection rate than females, particularly *Ascaris lumbricoides*, *Trichuris trichiura* and *Hymenolepis nana*. Hookworm was identified in equal proportion from males and females. Moreover, the co-infection also observed in males and females (Table 2). Younger age groups (5 8 years) were found to be more prevalent for *Ascaris lumbricoides*. However, *Hymenolepis nana* and *Teania species* were not detected at lower age groups. Participants at the age group of 9 12 years were found to be more affected by *Trichuris trichiura* (83.3%) and *Teania species* (62.5%) than other parasitic species. Relatively, older age groups (>12 years) were also affected by higher proportion of *Hymenolepis nana*, hookworm and *Ascaris lumbricoides* (Table 2).

As shown in Table 3, the majority (58.4%) of the students were used stream water for cooking and drinking purpose. This result has been found statistically significant and at higher risk for parasitic

infection (COR=1.4, 95% CI=0.47 4.15, $p=0.001$). However, students that used pipe borne water for drinking and cooking activities were found statistically insignificant ($p=0.55$). Those students who used latrine sometimes were also more likely (2.7 times) at higher risk to get infected with GIH parasites (Table 3). Other independent variables such as hand washing, raw meat eating, shoe wearing habit and finger nail status of the respondents were also assessed; however, none of these parameters were found statistically significant (Table 3).

Discussion

Although it is neglected disease in the developed world, GIH/STH infections are still remaining the major public health problem in developing countries, particularly in the tropics where appropriate parasitic growth factors exist. As a result, epidemiological study on the prevalence of GIH/STH infection in different region of the developing world is a primary objective to identify high-risk communities and formulate appropriate intervention [5, 8-10, 16-19]. In line with this view, the present study attempted to assess the prevalence of different GIH infections in primary school children in Dembi district (southwest Ethiopia).

In the current study, 30.9% overall prevalence of GIH which have public health importance were identified. Except 7.8% school children specimen samples showed double infection, most (92.2%) of the positive samples were identified single infection type. This was comparable with finding from elsewhere in Ethiopia and the world [13, 19-22]. For instance, the helminthic infection prevalence of 27.2% in Al-Ahsa (Saud Arabia), 31.8% in western city (Turkey), 34.0% in Kisumu city (Kenya), 35.6% in Hintallo-Wejerat (Ethiopia) and 36.5% Kathmandu valley (Nepal) reports were found to be almost in agreement with the current study (Table 4). However, the current study result has been found much higher (4.5 22.8%) than a report from Gondar [5] and Ambo [12] towns in Ethiopia and elsewhere in the world including Taiwan [23], Kenya [17], China [24] and Marshall Islands [25] (Table 4). Still, the present study prevalence was identified lower than study result from Tilili town (44.2%), Wolaita zone (72.2%), Azezo town (72.9%) and Chenchu town (81.0%) in Ethiopia (Table 4). Comparatively, higher helminthic prevalence were also reported in Saud Arabia (45.4%) El Salvador (53.0%), Tanzania (57.1%), India (75.6%), China (86.0%), Nigeria (86.2%) and Malaysia (88.2%) (Table 4). The possible explanations for the discrepancy between the present and previous study findings might be the result of variation in the geographic location, socio-economy of the subjects, selection of study participants, sample size, method of parasitological examination, time of the study, access to health care facilities and awareness. Indeed, the comparative result shown in Table 4 is from different geographic locations (Africa, Asia, Middle East, Latin America and Europe) and participants from different population group (pre-/school children, rural community, patients from medical centers and hospitals). The number of participants (sample size) were also varies higher ($n=6976$) from northern Samar in Philippines [19] and lower ($n=69$) from Yunnan in southwest China [26].

In this study, a total of six intestinal parasitic worm was detected which could be comparable with study in Nepal [11] that was identified six parasitic worms. As shown in Table 4, our finding was also

comparable to studies in Ethiopia (five parasites in Ambo town and seven parasites in Wolaita zone and Chenchu) and elsewhere in the world (five parasites in Kisumu city, western Kenya and seven parasites in El Salvador). Relatively, small number (three) of parasitic worm infection (Table 4) was reported in Guizhou (southwest China), Peninsular Malaysia and Uttar Pradesh (India). In school children, four intestinal parasitic worms (Table 4) were also reported in Nairobi city (Kenya), Western city (Turkey), Tilili town (Ethiopia) and Yunnan (southwest China). Studies conducted in Saud Arabia [20] and Taiwan [23] were also reported 20 and 13 intestinal parasitic worm species using hospital patient, respectively which was higher than maximum number of parasitic species reported in school children (nine) in Gondar town (north Ethiopia) [5] and Majuro city (Marshall Islands) [25].

The majority of infections in the current and previous studies were single infection types (Table 4). In this study, single infection and double infections were accounted 96.7% and 2.4%, respectively. Compared to the current study, double infections were significantly higher in school children reported in Chenchu town (26.5%) and Azezo town (47.3%) in Ethiopia, Makoko urban slum (45.7) and southwest (39.2%) in Nigeria, Nairobi city (33.3%) in Kenya, Majuro city (22.4%) in Marshall Islands and Yunnan (52.0%) in China. Compared to studies carried out with hospital and community participants, double infection has been found higher in most school age children studies (Table 4). This difference might be due to study population, environmental factors, investigation time and diagnosis method. It is obvious that the target population for the community and hospitals participants were at any age group and educational level, which was not true for school age children that have narrow age range and educational level.

In this study, STHs such as *A. lumbricoides* and hookworm infections were found the major public health problem. The prevalence of *A. lumbricoides* among school children in the current study area was found to be 43.3%. This prevalence of *A. lumbricoides* was higher than the national prevalence estimate (37%) in Ethiopia [7] and reports from other parts of the country such as 7.5% in northwest [5] and 28.9% south Gondar [33], 23.6% in Jimma [34], and 37.2% in Bushulo village [35]. Lower prevalence value of *A. lumbricoides* also reported in Kenya [21] and Malaysia [32] with a prevalence of 4.9% and 23.8%, respectively. However, the current study *A. lumbricoides* prevalence result was much lower than a report from Wondogent (83.3%) [36] and Chenchu town (60.5%) [9] in Ethiopia, Nigeria (57.2%) [30] and Nepal (57.9%) [18]. There are several studies that mentioned STHs vary among localities due to variations in geographic location, socio-economic conditions and hygienic condition of the population under consideration. Of course, the higher prevalence of *A. lumbricoides* in the current study than the national estimates and elsewhere could be due to lack of drinking water source and latrine usage, which has been found significantly (Table 3) associated with STH infection in the current study area. Compared with sources of drinking water, students using stream water for drinking and food preparation have found a statistical significant difference for STHs than students using pipe water for similar purpose. This supports that the transmission of *A. lumbricoides* infection which is contracted through ingesting embryonic egg through water and food [1]. In terms of gender, male students were identified more prevalent for *A. lumbricoides* than female students, which could be due to boys playing on soil and prefer to eat their food without proper hand washing (Table 2). Moreover, lower age (5-8 years) groups were found more prevalent to for *A. lumbricoides* than higher age groups (Table 2), which agrees with other

studies that said lower age groups are more affected than higher age groups [16, 32]. As reported in other studies [1, 16], latrine usage has been found a significant risk factor for STH including *A. lumbricoides* (Table 3).

The prevalence of hookworm infection among primary school children of Dembi district was identified 26.7%, which is higher than the national hookworm infection prevalence (16.0%) in Ethiopia [7]. The prevalence of this helminthic infection was also higher than a report from different areas of Ethiopia and other countries including 4.9% in Gamo area, south Ethiopia [37] and 12.9% in south Gonder [33], 6.1% in Kenya [21] and 17.8% in Nigeria [30]. Infection by hookworm was much lower when compared to a report from southeastern Ethiopia [14] and Philippines [19] which revealed 60.5% and 28.4%, respectively. In fact, hookworm disease caused by two worm species (*Ancylostoma duodenale* and *Necator americanus*) has been reported one of the most common infections in SSA which affects around 198 million people in the region [4, 6]. It causes iron deficient anemia and protein malnutrition [1]. Compared to age groups, hookworm infection has been found highest for older age groups (>12 years) than lower age groups (Table 2), which agrees with other studies [6, 26, 31]. For instance, Hotez and Kamath [6] mentioned that hookworm infection has steadily raised in the intensity during late childhood with either a peak or a plateau in adulthood.

The overall prevalence of *T. trichiura*, *Teania species* (6.7%), *S.stercoralis* (3.3%) and *H.nana* (3.3%) were found to be relatively very low. Interestingly, *T. trichiura* which is estimated 24% among STHs infection prevalence in Ethiopia from SSA prevalence proportion [4, 6], is found to be much lower (8.9%) among school children in Dembi district. This prevalence has also been lower than the previous school (23.1%) and community (57%) based study in Jimma/Ethiopia [34] and Peninsular Malaysia [32], respectively suggesting that relatively better toilet facilities, good hand washing habit and better awareness about health in the current study area.

Conclusions

Findings from this study revealed that GIH particularly STH infections were higher among the primary school children of Dembi district. The most prevalent parasite was *A. lumbricoides* and hookworm. Although the proportion was very low, *T. trichiura*, *S. stercoralis*, *Teania species* and *H. nana* were also detected in the stool sample. Males were highly affected sex by GIH than females. Infection rate of GIH was generally higher among age group 5-8 years than older groups. However, among STH the prevalence of hookworm infection was increased with an increased age group. Absence of safe water supply in the school as well as in the community led to higher prevalence of GIH infection among school children. Moreover, latrine usage habit was also a significant risk factor for GIH infection.

Abbreviations

CI: confidence interval; GIH: gastrointestinal helminth; OR: odds ratio; Ref: reference; SPSS: statistical package for the social sciences; SSA: sub-Saharan Africa; STH: soil transmitted helminth,

Declarations

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Availability of data and material

The data sets in this study are available from the corresponding author on reasonable request.

Authors' contribution

AG participated in the design of this study, wrote the manuscript, interpreting the results and discussion. AW participated in the design of this study and collect data. AW and WL participated in revising the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was reviewed and ethically approved by the Ethics Review Committee on Health Research, Arba Minch University. Permission to conduct the study was also obtained from Dembi Woreda Health Office, Educational Bureau and School Principals. Before the investigation was performed, the purpose of the study was explained to the school principal, laboratory technician, students and parents. The stool sample was collected after obtaining written consent from parents/guardians and assent from children participated in the study. Positive individuals for GIH infections referred to Dembi Health Center for proper treatment of cases and delivering health education for students and parents.

Consent for publication

Not applicable.

Competing interest

The authors declare that they have no competing interests.

Authors' detail

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Tables

Table 1 Prevalence of soil transmitted helminth infections among sex and age groups

Variables	Categories	Total		Infection [n(%)]		COR	95% CI	p-value
		No	%	Positive	Negative			
Sex	Male	145	49.8	55(37.9)	90(62.1)	2.0	1.17 3.22	0.011*
	Female	146	50.2	35(24.0)	111(76.0)	Refn	Refn	Refn
Age (year)	5-8	82	28.2	33(40.2)	49(59.8)	1.2	0.23 0.80	0.007*
	9-12	89	30.6	30(33.7)	59(66.3)	0.6	0.31 1.06	0.074
	≥13	120	41.2	27(22.5)	93(77.5)	Refn	Refn	Refn
Grand total	-	291	100	90(30.9)	201(69.1)	-	-	-

Numbers in parenthesis bracket indicates percentage value, OR=Crude odds ratio, CI=Confident interval, Refn=Reference, *=Significant at 95%

Table 2 Prevalence of single and multiple helminth infections among sex and different age groups

Parasite species	Total		Sex (n=90)				Age groups (n=90)					
			Male		Female		5-8 years		9-12 years		≥13 years	
	No	%	No	%	No	%	No	%	No	%	No	%
<i>Ascaris lumbricoides</i>	39	43.3	22	56.4	17	43.6	23	59.0	6	15.4	10	25.6
Hookworm	24	26.7	12	50.0	12	50	4	16.7	9	37.5	11	45.8
<i>Trichuris trichiura</i>	8	8.9	6	75.0	2	25	2	25.0	5	62.5	1	12.5
<i>Strongliodes stercoralis</i>	3	3.3	3	100	0	0	2	66.7	1	33.3	0	0
<i>Hymenolepis nana</i>	3	3.3	2	66.7	1	33.3	0	0	0	0	3	100
<i>Teania species</i>	6	6.7	6	100	0	0	0	0	5	83.3	1	16.7
<i>Ascaris lumbricoides</i> + hookworm	7	7.8	4	57.1	3	42.9	2	28.6	4	57.1	1	14.3
Total	90	100	55	61.1	35	38.9	33	36.7	30	33.3	27	30

Table 3 Bivariate logistic regression analysis of factors associated with STH infections

Variables Options		Total		Infection (%)		COR	95% CI	p- value
		No	%	Positive	Negative			
Drinking water source	Pipe borne	107	36.8	11.2	88.8	0.9	2.367	0.55
	Stream	170	58.4	41.8	58.2	1.4	0.468	0.001*
	Others	14	4.8	50.0	50.0	Refn	Refn	Refn
Latrine usage	Sometimes	30	10.3	60.0	40.0	2.7	0.038	0.001*
	Always	259	89.0	27.4	72.6	0.7	0.163	0.493
	Not at all	2	0.7	50.0	50.0	Refn	Refn	Refn
Hand washing	Yes	252	96.9	30.1	69.9	0.1	0.090	0.120
	No	9	3.1	55.6	44.4	Refn	Refn	Refn
Eating raw meat	Yes	148	50.9	35.1	64.9	1.5	0.906	0.115
	No	143	49.1	26.6	73.4	Refn	Refn	Refn
Shoe wearing	Always	210	72.2	31.0	69.0	2.2	0.438	0.334
	Sometimes	75	25.8	29.3	70.7	2.4	0.451	0.304
	Not at all	6	2.0	50.0	50.0	Refn	Refn	Refn
Finger nails status	Trimmed	253	80.8	29.8	70.2	0.8	0.431	0.389
	Not trimmed	56	19.2	35.7	64.3	Refn	Refn	Refn

COR= Crude odd ratio, CI= Confident interval, n= Number of samples, Refn=Reference, *=Significant at 95%

Table 4 Comparing helminthic parasitic worm for this study with other studies

area	Subjects	Number of sample	Number of parasitic spp.	Infection types (%)		GIH prev (%)	Reference
				Single	Two		
i district, Ethiopia	School children	291	6	97.6	2.4	30.9	This study
siung, Taiwan	Hospital patient	7360	13	99.9	0.1	4.5	[23]
bi city, Kenya	School children	1632	4	66.7	33.3	12.9	[17]
town, western Ethiopia	School children	375	5	89.8	10.2	18.4	[12]
ou, southwest China	Pre/school- age children	815	3	88.2	11.8	21.2	[24]
ur town, north Ethiopia	School children	405	9	88.5	11.5	22.7	[5]
o city, Marshall Islands	School children	400	9	75.8	24.2	22.8	[25]

ria, Saud Arabia	School	1298	7	95.7	4.3	27.2	[20]
	children						
ern city, Turkey	School	456	4	80.0	20.0	31.8	[22]
	children						
u city, western Kenya	School	1308	5	90.6	9.4	34.0	[21]
	children						
lo-Wejerat, Ethiopia	Community	800	10			35.6	[13]
andu valley, Nepal	People	156	6	77.2	22.8	36.5	[18]
	in/outside						
	valley						
own, Ethiopia	School	385	4	90.8	9.2	44.2	[8]
	children						
western, Saud Arabia	Hospital	130	20	92.3	7.7	45.4	[27]
	patient						
vador	Rural	449	7	57.3	42.7	53.0	[28]
	communities						
za, North-western Tanzania	Patient in	3152	8	100	0	57.1	[29]

	medical center						
west Nigeria	School	1059	8	60.8	39.2	66.2	[30]
	children						
ta zone, southern Ethiopia	School	503	7	100	0	72.2	[10]
	children						
town, northwest Ethiopia	School	354	12	52.7	47.3	72.9	[11]
	children						
ern Samar, Philippines	Rural	6976	4	100	0	75.6	[19]
	communities						
Pradesh, India	School	6421	3	91.9	8.1	75.6	[16]
	children						
aha town, southern Ethiopia	School	400	7	73.5	26.5	81.0	[9]
	children						
n, southwest China	School-aged	69	4	48	52.0	86.0	[26]
	children						
ko urban slum, Nigeria	School	384	8	54.3	45.7	86.2	[31]

children

sular Malaysia	Community	500	3	100	0	88.2	[32]
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= Data not reported, GIH prev=Gastrointestinal helminths prevalence