Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.11, 2015 www.iiste.org

Prevalence of Intestinal Helminthiasis and Associated Risk Factors among Schoolchildren in Dawro Zone, Southern Ethiopia

Bereket Alemayehu* Zewdneh Tomass
Wolaita Sodo University, College of Natural and Computational Sciences, Department of Biology, Biomedical Sciences Division, P.O Box 138, Wolaita Sodo, Ethiopia
*E-mail of the corresponding author: bereketalemayehu@gmail.com

Abstract
Intestinal parasitic infections are among the most common infections worldwide and these infections tend to be higher in schoolchildren than other members of the community. Therefore, the aim of this study is to determine infection prevalence and associated risk factors of intestinal helminths among schoolchildren in Dawro Zone, Southern Ethiopia. A cross-sectional parasitological study was conducted between May to July, 2014 among children in selected primary schools. Using standard parasitological methods, 374 randomly selected children were examined for soil transmitted helminths and *S. mansoni* among which 224 (59.9%) were found positive at least for one intestinal helminth. Seven helminth species were identified in the study subjects with the most dominant parasite being *Ascaris lumbricoides* (47.3%) followed by *Trichuris trichiura* (23.5%) while *Schistosoma mansoni* (1.1%) being the least dominant. The present study indicated that there is a need for integrated control program through periodic deworming, enhancing socio-economic status, supplying safe water for drinking and promoting health education so as to bring lasting impact on transmission of intestinal helminthic infections.
Keywords: intestinal helminths, schoolchildren, Dawro Zone, Southern Ethiopia

1. Introduction

Intestinal parasitic infections are among the most common infections worldwide. It is estimated that 3.5 billion people are affected, and 450 million are ill as a result of these infections (WHO, 2002). For example, the global burden caused by soil transmitted helminthiasis is estimated to be 39 million disability-adjusted life years (DALYs), whereas the burden due to intestinal and urinary schistosomiasis is estimated to be 4.5 million DALYs (WHO, 2002; Hotez *et al.,* 2006). Current estimates showed that at least more than one-quarter of the world's population is chronically infected with intestinal parasites and most of these people live in developing countries (Fincham *et al*., 2003; De Silva *et al*., 2003). Apart from causing chronic morbidity and mortality, infection with intestinal parasites has cause iron deficiency anemia, growth retardation and impaired cognitive development in children (Evans and Stephenson, 1995).

Intestinal helminth infections are common among school age children and tend to occur in higher intensities in this age group (Seid *et al*., 2015). Younger children are predisposed to heavy infections with intestinal parasites since their immune systems are not yet fully developed (Rao *et al*., 2006) and they also habitually play in faecally contaminated soil in developing countries of the tropics. In many developing countries intestinal parasitic infection is a major health problem with infection prevalence ranging from 14.6 to 91% (Kloos, H., 1995).

In Ethiopia, intestinal parasitic infections are of serious public health concern (Mengistu *et al.,* 2007). According to a report by the Ministry of Health, helminthiasis is the third leading cause of outpatient visits in health institutions in the years 2005–2006 in Ethiopia (FMoH, 2006). The range of infection prevalence, though wide, still illustrates a high prevalence of these infections in the county. A study conducted by the Central Statistical Agency (CSA) of Ethiopia in 2005, found that underweight, wasting and stunting in children aged under-five years in Ethiopia were 36%, 10%, and 51%, respectively (CSA, 2005) into which several factors played a role among which intestinal parasite infection might be one of the causes. Since intestinal parasitic infections are associated with poor socioeconomic class and unsanitary conditions, people living in such settings in rural Ethiopia are at substantially increased risk for intestinal parasitic infections. Previous studies conducted in Ethiopia revealed higher prevalence of parasitic infection (Endris *et al.*, 2010; Erko *et al.*, 2006; Legesse and Erko, 2004) and its association with under nutrition (Nguyen *et al.*, 2012). Several factors like climatic conditions, poor sanitation, unsafe drinking water, and lack of toilet facilities are the main contributors to the high prevalence of intestinal parasites in the tropical and sub-tropical countries (Ali *et al.*, 1999). Further, lack of awareness about mode of transmission of intestinal parasites increases the risk of infection. Hence, a better understanding of the above factors, as well as how social, cultural, behavioral and community awareness affect the epidemiology and control of intestinal parasites may help to design effective control strategies against these diseases (Mengistu *et al.,* 2007). Although several studies have been conducted on the distribution and prevalence of intestinal parasites in Ethiopia, no or little is known about the epidemiology of intestinal helminth infections in schoolchildren of Dawro Zones. Therefore, the present study aimed to investigate intestinal helminth infections and associated risk factors among schoolchildren in Dawro Zone.

2. MATERIALS AND METHODS

2.1 Description of Study Area

This study was conducted in primary schools of selected districts in Dawro Zone, Southern Ethiopia. Dawro Zone is located at about 528 kms south of Addis Ababa, the capital city of Ethiopia. This Zone has a total population of 489,577 with an average of 101.69 people per square kilometer. As agriculture is a predominant economic sector in the zone, the majority of people earn their livelihood from subsistence farming (CSA, 2007; SNNPR, 2002). Dawro Zone has rugged topography comprising high, middle and lowland agro ecologies. The highland, "Dega", agro-ecology receives rain for most of the year. The altitude in the Zone ranges from 500 to 3000 above sea level (CSA, 2007).

2.2 Data and Stool Collection Process

A cross-sectional study was carried out from May to July, 2014. After collecting the socio-demographic and other relevant data by using semi-structured interview questionnaire, stool samples were collected from study subjects who had no history of taking anti-intestinal drug/s in two months prior to screening. Subjects who had any other serious chronic infections were excluded from the study and those who were able to give stool samples were included in the study.

About 4g of fresh fecal samples were collected from each consenting study subject and placed in clean and labeled stool cups. At the time of stool sample collection, general information about the study subjects such as age, sex and consistency of the stool were recorded. A portion of stool sample was used to prepare Kato slide for each child in the field. The remaining portion of stool sample was preserved in SAF (Sodium acetate Acetic acid Formalin) solution. The preserved stool samples were transported to the Biomedical Sciences Laboratory, Biology Department, Wolaita Sodo University and microscopic examination of the stool samples was carried out after the samples were processed by the formalin-ether concentration method as described by Ritchie (Ritchie, 1948), with slight modification. In brief, the stool samples were sieved with cotton gauze and transferred to 15 ml centrifuge tube. Then 7 ml of 10% formalin and 3 ml of diethyl ether was added and centrifuged for 2 min at 2000 rpm. The supernatant was discarded and the residues were transferred to microscopic slides and observed under light microscope at 100× and 400× magnifications for the presence of intestinal parasites. Kato-Katz thick stool smears were used to estimate helminth infection intensities. Since a template delivering 41.7 mg of stool was used to prepare Kato slides, the egg of each parasite in the slide was counted and the number of eggs was multiplied by 24 to calculate EPG for each helmitnh species to estimate the infection intensity.

2.3 Sample Size Determination and Sampling Techniques

Sample size was determined using a single population proportion formula, $n=(Z\alpha/2)^2 * P\ (1 - P)/\ d^2$ where n is a sample size to be determined, $Z\alpha/2$ is a critical value using 50% expected prevalence P with 5% absolute precision d at 95% confidence interval. Based on this, the sample size n for the present study was determined to be 384. The study subjects were then randomly selected from each of the selected primary schools using their registration roster as a sapling frame.

2.4 Data management and Analysis

The collected data were cleaned and entered into excel spread sheet and transported into SPSS statistical software version 16 for analysis. Chi-square ($\chi 2$) was used to verify possible associations between infection and exposure to different factors. Logistic regression was performed to see the magnitude of risk of helminth infection to possible factors by computing the Odds Ratios (ORs) at 95% confidence level. All probability values were considered statistically significant when the calculated P-value was equal to or less than 0.05.

2.5 Quality Control

Before starting the actual work, quality of reagents and instruments were checked by experienced laboratory technologist. Standard laboratory techniques were used as described by the WHO (WHO, 1991). The specimens were also checked for serial number, quality and procedures of collection. To eliminate observer bias, each stool sample was examined by two laboratory technicians. The technicians were not informed about the health and other status of the study participants. In cases where the results seemed discordant, a third senior reader was used. The result of the third expert reader was considered the final result.

2.6 Ethical Considerations

The study was reviewed and approved by the Ethics Review Committee of College of Natural and Computational Sciences, Wolaita Sodo University, Ethiopia. Ethical considerations were addressed by treating positive individuals using standard drugs under the supervision of a local nurse. The objective of the study was explained to the parents or guardians, the schools administration and primary health care providers. Oral consent was taken from parent representatives at schools in order for the schoolchildren to participate in the study. Name and other identifying information of the children were kept confidential. Finally, consent was obtained to disseminate the research findings to all relevant stakeholders including publication on reputable journals.

3. Results

3.1 General Characteristics of the Study Participants

Of the 384 selected individuals, 374 participated in the study making the respondent rate 97.4% and among these, 164 (43.9%) and 210 (56.1%) were males and females, respectively. Two hundred seventy (72.2%) of the respondents had parents with at least primary education level. 277 (74.1%), 51 (13.6%), (11%) and 5 (1.3%) study subjects mainly depended on piped, well, spring and surface water sources for drinking and household consumption, respectively (Table 1).

3.2 Prevalence of Intestinal Helminths

The overall prevalence of intestinal helminths in schoolchildren of Dawro Zone was 59.9% (224/374). There was a significant difference in school-wise helminth infection prevalence (P= 0.000). Infection prevalence of intestinal helmithns in male and female children accounted for 25.9% (97/374) and 33.4% (125/374), respectively. Infection prevalence of intestinal helmiths was not affected by sex of the children (*P* = 0.941). Infection prevalence of intestinal helminths was recorded to be 27.5% (103/374) and 31.8% (119/374) in children aged 5-9 and 10-14 years, respectively. Moreover, age did not have effect on parasite prevalence (P= 0.088) (Table 1).

Seven different helminth species were identified among the study subject with the most dominant parasite being *Ascaris lumbricoides* 47.3% (177/374) followed by *Trichuris trichiura* 23.5% (88/374), *Enterobius vermicularis* 5.6% (21/374), *Taenia* spp. 5.3% (20/374), *Hymenolepis nana* 5.1% (19/374), hookworm 3.5% (13/374) and *Schistosoma mansoni* 1.1% (4/374). Distribution of intestinal helminth infections among the primary schools surveyed showed highest infection in children of Gibira Kema 44.6% (100/224) followed by Eyesus 36.2% (81/224) and Sore 19.2% (43/224), respectively (Table 2).

Table 1. The prevalence of intestinal parasitic infection with respect to socio-demographic characteristics in Dawro Zone, Southern Ethiopia, 2014.

Variables		**Positive n(%)**	**Negative n(%)**	**Total n(%)**	**P-value (X^2)**
Sex	Male	97 (59.1)	67 (40.9)	164	0.941 (0.005)
	Female	125 (59.5)	85 (40.5)	210	
Age (Year)	5-9	103 (64.4)	57 (35.6)	160	0.088 (2.917)
	10-14	119 (55.6)	95 (44.4)	214	
Primary school	Sore	42 (32.3)	88 (67.7)	130	0.000 (65.944)*
	Eyesus	81 (66.4)	41 (33.6)	122	
	Gibra	99 (81.1)	23 (18.9)	122	
Parents' education level	No formal education	76 (73.1)	28 (26.9)	104	0.001 (11.239)*
	At least primary	146 (54.1)	124 (45.9)	270	
Major source of drinking water	Pipe	155 (44.0)	122 (56.0)	277	0.056 (7.565)
	Wells	39 (76.5)	12 (23.5)	51	
	Spring	25 (61.0)	16 (39.0)	41	
	Surface water	3 (60)	2 (40)	5	
Hygiene education by parents	None	0 (54.5)	3 (100)	3	0.008 (9.693)
	Sometimes	184 (57.5)	136 (42.5)	320	
	Usually	38 (74.5)	13 (25.5)	51	

*Statistically significant value (P ≤ 0.05)

Table 2. Prevalence of intestinal helminths in selected primary schools of Dawro Zone, Southern Ethiopia, 2014.

Helminth Parasites	**No. infected children (%)**			**Total (Overall prevalence)**
	Sore (n=130)	Eyesus (n=122)	Gibra Kema(n=122)	
S. mansoni	4 (100)	0	0	4 (1.1)
A. lumbricoides	27 (15.3)	66 (37.3)	84 (47.5)	177 (47.3)
Hookworm	7 (53.8)	0	6 (46.2)	13 (3.5)
T. trichiura	11 (12.5)	32 (36.4)	45 (51.1)	88 (23.5)
Taenia spp.	1 (5.0)	4 (20.0)	15 (75)	20 (5.3)
H. nana	3 (15.8)	9 (47.4)	7 (36.8)	19 (5.1)
E. vermicularis	0	6 (28.6)	15 (71.4)	21 (5.6)
Overall infection	43 (19.2)	81 (36.2)	100 (44.6)	224 (59.9)

3.3 Faecal Egg Counts of Helminths

The overall arithmetic mean faecal egg counts for STH and *S. mansoni* were 1953 , 56 , 47 , 12 and 0.4 EPG for, *A. lumbricoides*, *T. trichiurs*, *E. vermicularis, H. nana* and *S. mansoni*, respectively (Table 3).

Table 3. Arithmetic mean EPG for STH and *S. mansoni* among schoolchildren in selected primary schools of Dawro Zone, Southern Ethiopia, 2014.

Variables		**Parasites identified**				
		S. mansonai	*A. lumbricoide*	*T. trichuria*	*H. nana*	*E. vermicularis*
Age (years)	5-9	0	2797.20	73.95	24.75	104.85
	10-14	0.67	1321.79	42.62	3.14	3.93
	P⋆	0.100	0.001*	0.151	0.059	0.001*
Sex	Male	0	1874.20	54.44	1.76	28.39
	Female	0.69	2014.51	57.26	20.69	61.71
	P⋆	0.092	0.751	0.897	0.098	0.253
Overall		0.4	1953	56	12	47

⋆ P values computed for independent-samples t test
*Statistically significant vale ($P \leq 0.05$)
STH, soil transmitted helminths

3.4 Associated Risk Factors

The odds of intestinal helminth infections in children from Gibira Kema and Eyesus Primary Schools were more likely to occur then in children from Sore Primary School ($p < 0.05$, 95% CI = 0.022-0.619). There were no statistical differences between parasite-infection and factors such as age, sex, parents' education level and drinking water sources ($P > 0.05$) (Table 4).

Table 4**.** Association of possible risk factors with STH and *S. mansoni* among schoolchildren in selected primary schools of Dawro Zone, Southern Ethiopia, 2014.

Variables	**No. examined (%)**	**OR (95%CI)**	**p-value**
Age group (in years)			
5-9	160 (42.8)	0.667 (0.392, 1.136)	0.136
10-14	214 (57.2)	1.00	
Sex			
Male	164 (43.9)	0.882 (0.548, 1.421)	0.607
Female	210 (56.1)	1.00	
Parents' education level			
No formal education	104 (27.8)	1.155 (0.644, 2.072)	0.629
At least primary education	270 (72.2)	1.00	
Primary School			
Sore	130 (34.8)	0.057 (0.022, 0.148)	0.000*
Eyesus	122 (32.6)	0.253 (0.104, 0.619)	0.003*
Gibira Kema	122 (32.6)	1.00	
Drinking water source			
Pipe			
No	97 (25.9)	0.698 (0.255, 1.908)	0.483
Yes	277(74.1)	1.00	
Well			
No	318 (85.0)	1.341 (0.471, 3.817)	0.583
Yes	56 (15.0)	1.00	
Spring			
No	286 (76.5)	1.611 (0.702,3.695)	0.261
Yes	88 (23.5)	1.00	
Surface water			
No	264 (70.6)	0.747 (0.401, 1.394)	0.360
Yes	110 (29.4)	1.00	

OR: odds ratio; CI: confidence interval
*Statistically significant value ($P \leq 0.05$)
Variables entered: Age group, sex, primary schools, parent education level, tap water, well water, spring water, surface water.

4. Discussions

The present study revealed 59.9% prevalence of intestinal helminth infections in 374 schoolchildren aged 6-14 years in 3 randomly selected primary schools in Dawro Zone, Southern Ethiopia. This is perhaps the first study to report intestinal helminth infections in schoolchildren in the study area. Such a study on the prevalence of intestinal helminth infection in different localities had a primary objective to identify high-risk communities and formulate appropriate interventions. In line with this view, the present study attempted to assess the prevalence of different intestinal helmintic infections in schoolchildren of selected primary school in the Zone. The results of the study showed the occurrence of seven intestinal helminth-parasites with the most dominant parasites being soil transmitted helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, *Hymenolepis nana* and *Enterobius vermicularis*. The overall prevalence of 59.9% with one or more intestinal helmith-parasites found in this study was higher than other similar studies reported from Gondar Community School, Northwest Ethiopia (34.2%) (Gelaw *et al*., 2013), from Gamo area, Southern Ethiopia (39.9%) (Wegayehu *et al.*, 2013) and from Babile (27.2%) (Tadesse, 2005). On the other hand, the prevalence observed in this study was lower than the findings reported from Gondar (72.9%) (Endris *et al*., 2010), from Jimma (83%) (Mengistu *et al*., 2007) and from South East of Lake Langano (83.8%) (Legesse and Erko, 2004). These variations in prevalence might be due to the differences in altitude, climatic conditions, environmental sanitation, socio-economic and educational status of parents and study subjects, and previous control efforts.

In the present study, the most frequently observed and widely distributed parasites were *A. lumbricoides* (47.3%) and *T. trichiura* (23.5%); while others such as *E. vermicularis* (5.6%), *Taenia* spp. (5.3%), *H. nana* (5.1%), Hookworm sp. (3.5%) and *S. mansoni* (1.1%) were less frequently seen. The lowest prevalence of *S. mansoni* in the present study might be due to the ecological conditions of the areas where the schools were found.

The school-wise prevalence of intestinal helminth infection was observed in the present study as there were higher prevalence (81.1%) and (66.4%) in Gibira Kema and Eyesus Primary Schools respectively than (32.3%) in Sore Primary School. This high prevalence in Gibira Kema and Eyesus primary schoolchildren might be due to the temperature, humidity and rainfall factors in the highland areas of Dawro where the two schools were found. These areas remained wet for most of the months in a year. On the other hand, the lowest infection prevalence (32.3%) seen in children of Sore, a lowland school, mighty be due to the dry ecological condition of the area. This explanation was in agreement with the explanation given for the lower prevalence of intestinal parasites among lowland dwellers in Gamo Gofa area (Wegayehu *et al*., 2013). In Ethiopia, a nationwide study conducted on ascariasis indicated a low prevalence of ascariasis in the low and dry areas of the country (Tedla and Ayele, 1986). In general, the significant spatial heterogeneity in the prevalence of intestinal helminth infections among the schools in Dawro might be due to the differences in socio-econmic, environmental, climatic and sanitary conditions. Even though there was a difference in the infection prevalence among the schools, it was observed that the parasites species found were more of less similar in type. This might be due to the reason that in adjacent areas, like the present case, localities were more likely to display similar parasite community structure among human hosts.

In addition to the prevalence study, the current study assessed the predisposing factors for the intestinal helminth infection in the study zones. Nowadays, an active role has been played by the government of Ethiopia through health extension workers to improve hygiene status at household level. Although a lot has been done by the government to increase health promoting activities in the study area to prevent intestinal parasitic infections in general, there still exists a problem to come to the desired level in performing sanitary practices by inhabitants at household level. The poor hygiene practice observed in this study was substantiated by the findings of questionnaire data obtained from the householders in the areas. Although 72.2% of parents of the study subjects had had at least primary education, majority of them were at primary level. In the present study, 27.8% of children's parents had had no formal education and this condition might slightly risk their children for intestinal helmint infections as compared to the children whose parents had had at least primary education. The present study clearly showed a significant association of parents' education level with the status of helminth infection in their children in that children who had had educated parents were seen to have lower intestinal helminth infection. Similar finding was reported from a study conducted in Zarima town (Alemu *et al.*, 2011). It is understandable that education plays a great role to maintain community and personal hygiene and hence, higher level of education is usually associated with better hygiene awareness which reduces the prevalence of parasitic infections (McManus *et al.*, 2014); Hosain *et al.*, 2003).

Even though the present study assessed potential risk factors such as socio-economic condition, school-wise comparison, parents educational status and drinking water sources in relation to the helminth infection prevalence, there was no statistical difference seen in the associations between parasite-infections and many of the likely factors for the infections except the school-wise comparison. This might be because some of the assumed factors may not directly be associated to some helminth infections. For instance, transmission of soil transmitted helminthiasis was not directly associated to source of drinking water; whereas, transmission of schistosomiasis was dependent on the presence of local cercarial-infested water sources (Tadesse, 2005). In addition to the mentioned reasons, the indifferent infection prevalence regardless of socio-economic condition, source of drinking water and hygiene conditions might be due to the reason that at school age in endemic areas where indiscriminate open air defecation exists, children might be equally exposed to contaminated soil and water environments due to their outdoor activities.

5. Conclusion

The present study indicated that intestinal helminthic infections observed among schoolchildren were common public health problems in Dawro Zone, Southern Ethiopia. Among the identified intestinal helminthic infections, infections due to soil transmitted helminths were the most and *Schistosoma mansoni* was the least common with varying magnitudes in the study areas. Poor sanitary condition, lack of clean drinking water supply and low level of education were supposed to play important role in establishing intestinal helminth infections in the study area. Therefore, there is a need for integrated control program through periodic deworming, enhancing socio-economic status, supplying safe water for drinking and promoting health education so as to bring lasting impact on transmission of intestinal helminthic infections. Furthermore, the existing health education being delivered to the community through Health Extension Workers should be strengthened and its implementation should be regularly monitored by the health sector monitory system.

6. Acknowledgments

We would like to thank Wolaita Sodo University for providing financial and logistic support to conduct the study. We are also thankful to the Dawro Hospital for material support. We also extend our gratitude to the Health and education offices of Dawro Zone and their respective district administrators for their cooperation and prompt responses. We also appreciate the contributions of the data collectors in collecting data for the study.

REFERENCES

Alemu A, Atnafu, A., Addis, Z., Shiferaw, Y., Teklu, T., Mathewos, B., Birhan, W., Gebretsadik, S. and Gelaw, B. (2011). Soil transmitted helminths and Schistosoma mansoni infections among schoolchildren in Zarima town Northwest Ethiopia. *BMC Infect Dis*, 11:189.

Ali, I., Mekete, G. and Wodajo, N. (1999). Intestinal parasitism and related risk factors among students of Asendabo Elementary and Junior Secondary school, South Western Ethiopia. *Ethiop. J. Heal. Dev.* 13:157.

CSA, (2005). Ethiopia, Demographic and Health Survey. Central Statistic Agency of Ethiopia.

CSA, (2007). Summary and Statistical Report of the 2007 Population and Housing Census Results. Federal Democratic Republic of Ethiopia: Population Census Commission. Central Statistic Agency of Ethiopia.

De Silva, N.R., Brooker, S., Hotez, P.J., Montresor, A. and Engels, D. (2003). Soiltransmitted helminth infections: Updating the global picture. *Trends Parasitol.* 19: 547-551

Endris, M., Lemma, W. Belyhun, Y., Moges, B., Gelaw, A. and Angaw, B. (2010). Prevalence of intestinal parasites and associated risk factors among students of Atse Fasil general elementary school Azezo, Northwestern Ethiopia. *Ethiop. J. Heal. Biomed. Sci.* 3(1):25–33.

Erko, B., Balcha, F. and Kifle, D. (2006). The ecology of *Biomphalaria sudanica* in Lake Ziway, Ethiopia. *Afric. J. Ecol.* 44:347–352.

Evans, A.C., Stephenson, L.S. (1995). Not by drugs alone: the fight against parasitic helminths. *World Health Forum*, 16:258–261.

Fincham, J.E., Markus, M.B. and Adams, V.J. (2003). Could control of soil-transmitted helminthic infection influence the HIV/AIDS pandemic. *Acta. Trop.* 86: 315-333.

FMoH, (2006). Federal Ministry of Health. Health and health related indicators.

Gelaw, A., Anagaw, B., Nigussie, B., Silesh, B., Yirga, A., Alem, M., Endris, M. and Gelaw, B. (2013). Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: a cross-sectional study. *BMC Public Health*., 13:304.

Hosain, G.M., Saha, S. and Begum, A. (2003). Impact of sanitation and health education on intestinal parasite infection among primary school aged children of Sherpur, Bangladesh. *Trop. Doct*., 33:139-43.

Hotez, P.J., Molyneux, D.H., Fenwick, A., Ottesen, E., Ehrlich, S. and Sachs, J.D. (2006). Incorporating a rapid-impact package for neglected tropical diseases with programs for HIV/AIDS, tuberculosis, and malaria. *PLoS Med*. 3:e102.

Kloos, H. (1995). Human behavior, health education and schistosomiasis control: a review. *Soc. Sci. Med.* 40:1497–1511.

Legesse, M. and Erko, B. (2004). Prevalence of intestinal parasites among school children in rural area close to the south east of Lake Langano, Ethiopia. *Ethiop.J.Heal.Dev.* 18(2):116–120.

McManus, P. D., Bieri, F.A., Li, Y., Williams, G.M., Yuan, L. and Henglin, Y. (2014). Health education and the control of intestinal worm infections in China: a new vision. *Parasites & Vectors*, 7:344.

Mengistu, A., Gebre-Selassie, S. and Kassa, T. (2007). Prevalence of intestinal parasitic infections among urban dwellers in southwest Ethiopia. *Ethiop. J. Heal. Dev.* 21:12-7.

Nguyen, N.L., Gelaye, B., Aboset, N., Kumie, A., Williams, M. and Berhane, Y. (2012). Intestinal Parasitic Infection and Nutritional Status among School Children in Angolela, Ethiopia. *J. Prev. Med. Hyg.* 53: 157–164.

Rao, V., Sugunan, A., Murhekar, M. and Sehgal, S. (2006). Malnutrition and high childhood mortality among the Onge tribe of the Andaman and Nicobar Islands. *Public Health Nutrition*, 9:19-25.

Ritchie, L.S. (1948). An ether sedimentation technique for routine stool examination. Bull *US Army Med. Dept*., 8:326–329.

Seid, M., Dejene, T. and Tomass, Z. 2015. Prevalence of Intestinal Helminths and Associated Risk Factors in Rural School-Children in Were-Abaye Sub District, Tigray Region, Northern Ethiopia. Acta parasitologica Globalis. 6(1): 29-35.

SNNPR, (2002). Southern Nations Nationalities and Peoples Region, Health profile of Wolaita Zone, Ethiopia.

Tadesse, G. (2005). The prevalence of intestinal helminthic infections and associated risk factors among schoolchildren in Babile town Eastern Ethiopia. *Ethiop.J.Heal.Dev*. 19(2):140–147.

Tedla, S. and Ayele, T. (1986). Ascariasis distribution in Ethiopia. *Ethiop.Med.J.* 24:79–86.

Wegayehu, T., Tsalla, T., Seifu, B. and Teklu, T. (2013). Prevalence of intestinal parasitic infections among highland and lowland dwellers in Gamo area, South Ethiopia. *BMC Public Health.* 13:151.

WHO, (1991). Basic Laboratory Methods in Medical Parasitology, World Health Organization, Geneva, Switzerland.

WHO, 2002. Prevention and control of schistosomiasis and soil-transmitted helminthiasis: first
report of the joint WHO expert committees. WHO Tech. Rep. Ser., 912:1–57. World Health Organization. Control of Tropical Diseases. WHO, Geneva.