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**REVIEW ARTICLE**

# A REVIEW OF INTESTINAL HELMINTHIASIS IN ETHIOPIAN SCHOOL CHILDREN AND THE NEEDED EFFORTS FOR SCHOOL-BASED INTERVENTION

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## ABSTRACT

Ethiopia is one of the most populous countries in Africa. This huge population, coupled with the absence of basic social amenities, auspicious climatic environment, and weak public health infrastructure favor the transmission of intestinal helminthiasis. Understanding the prevalence of intestinal helminth infections is necessary to plan control strategies and focus on highly endemic regions for preventive chemotherapy and improved sanitation facilities. This paper reviewed the prevalence of intestinal helminthiasis among schoolchildren, associated risk factorsand recommended control effortsin Ethiopia. To achieve this based on PRISMA guidelines a systematic search ofpublished literature was carried out from the year 2000 to 2017.A careful screening of the identified literature yielded 28 studies that reported the prevalence of at least three intestinal helminths among schoolchildren from 5 different states of Ethiopia.Form the 28 research articles, 22, 21 and 14 research findings reported Hookworm, *A. lumbricoides*, and *S. mansoni*as one of the three most common intestinal helminths in the study area respectively. A higher than 20% prevalence for Hookworm *A. lumbricoides*and *S. mansoni* was reported from 8 different locations scattered across the country. As WHO recommends School-based mass drug administrationto control intestinal helminth infectionis a feasible and cost-effective control strategy and when it is accompanied with provision of safe water supply, proper usage of latrine, vector control and health educationa long-term impact can be achieved in Ethiopia.



## INTRODUCTION

Intestinal parasites infect the lumen and lining tissue of the lumen of the small and large intestine. Intestinal parasitic infections mainly caused by intestinal helminthes and protozoan parasites (Haque, 2007). Helminth infections are caused by parasitic worms found in the intestinal tract, urinary tract, or blood of humans (Harhay*et al.*, 2010). Many of them are responsible for soil-transmitted helminthiasis (STH) and intestinal schistosomiasis. Five intestinal nematodes: *Ascarislumbricoides, Trichuristrichiura, Strongyloidesstercoralis* and the Hookworms, *Ancylostomaduodenale* and *Necatoramericanus*, are collectively known as soil-transmitted helminths (STH) due to their ability to survive in the environment and be transmitted through soil contaminated with faeces(WHO, 2012). In Ethiopia, intestinal schistosomiasis is caused by *S. mansoni* (MoH, 2013).STH affect more than 2 billion people world-wide (Bethony*et al.*, 2006) and rank among the most prevalent neglected tropical diseases in sub-Saharan Africa (Hotez*et al.*, 2009).

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Hookworm is widely distributed in both rural and urban areas. While *Ascarislumbricoides* and *Trichuristrichiura* are irregularly distributed, they are mainly found in urban areas (Brooker *et al*., 2010). Intestinal schistosomiasis is also a major cause of disease burden in developing countries, especially in sub-Saharan Africa (WHO, 2012). Helminth infection is a major cause of disease burden among children in developing countries, especially in sub-Saharan Africa (WHO, 2012). According to Deribe *et al.* (2012) report, Ethiopia stands out for having the largest number of neglected tropical diseases cases following Nigeria and the Democratic Republic of Congo. Ethiopia is estimated to have the second highest burden in terms of ascariasis, and the third highest burden of Hookworm. A third of Ethiopians are infected with ascariasis, one quarter is infected with trichuriasis and one in eight Ethiopians lives with hookworm. A national school health and nutrition survey done in 2005-2006 revealed that 23.2% of school children were infected with *A. lumbricoides,* 7.4% by *T. trichiura* and 9.1% by hookworms. The overall national prevalence of any helminth infection was 29.8% with variable degree of prevalence among regions, whereby SNNP (51%) and Gambella (51%) have the highest prevalence (MoH, 2013). Transmission of intestinal helminthiasis (IHs) within the community is predominantly related to environmental factors, such as water supply for domestic and personal hygiene, sanitation and housing condition and other factors such as socio-economic, demographic, health related behavior and level of education are known to influence this infection. Poverty, illiteracy and hot and humid tropical climate are also the factors associated with transmission His (Alamir*et al*., 2013; Gelaw *et al*., 2013; Wegayehu *et al*., 2013; Workneh *et al*., 2014). The highest prevalence and intensity of infection are usually observed in school-aged children (WHO, 2012). The presence of intestinal parasitic infections may have multiple effects among children including physical and mental developments. The presence of chronic and heavy intestinal parasitic infection cause intestinal bleeding, malabsorption of nutrients, nutritional deficiency, destruction of cells and tissues and other associated effects. The overall effect of these results in growth retardation, reduced mental development, school absenteeism, low academic performance, susceptible to malnutrition and infection (Haque, 2007, Harhay *et al*., 2010, WHO, 2012).

There is a growing body of evidence that school-based health services such as treatment of schistosomiasis and intestinal nematode infections can be delivered at low cost. The main objective of current control efforts is to reduce morbidity of people by decreasing their parasite biomass of gastrointestinal nematodes (WHO, 2012). Significant efforts have been and are being made to control their impact in endemic countries, with the ultimate target being to eliminate morbidity by 2020 (WHO, 2015). The World Health Organization (WHO) recommends regular mass drug administration (MDA) among school-aged and preschool-aged children in areas where prevalence exceeds 20% (WHO, 2012). In areas of co-endemicity, integrated MDA is the recommended approach, e.g. albendazole-praziquantel for controlling STH and schistosomiasis (WHO, 2015). This is achieved by treating target groups, including children, with anthelmintic drugs (Harhay*et al*., 2010). School-based deworming represents the most cost-effective and feasible intervention strategy for IH and the greatest need for control exists in sub Saharan Africa (Brooker *et al*., 2010). Primary school children were used to index the assessment of community prevalence. In Ethiopia, to achieve this, numerous epidemiological surveys of IHs were conducted to assess the prevalence and associated risk factors in school children (Dejene and Asmelash, 2010; Gelaw *et al*., 2013; Abera and Nibret, 2014; Taye, 2014; Kidane *et al*., 2014; Workneh *et al*., 2014; Gebretsadik, 2016; Maru, 2017; Hailegebriel, 2017). Many of these studies reported varied prevalence rate of IHs, risk factors, species and needed efforts. The aim of this article was to review the prevalence of IH, associated risk factors contributing to their prevalence, most predominant species and needed efforts to improve school children's general well-being.

**Methods: Search Strategy and Data extraction**

This article is based on literature search and information from available data on IHs in Ethiopia. We did a review based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to identify all relevant publications pertaining to the prevalence of intestinal helminthes in Ethiopia. We systematically searched PubMed and Web of knowledge from September 1, 2000 to September 30, 2017. We did not search before the year 2000 because our goal was to inform decision-making rather than providing a historical perspective. In this regard, it is pertinent to mention that intestinal helminthic infections are often a function of sanitation, health care and economic condition. In this decade Ethiopia has done great effort in implementing community based and school based mass deworming programs to reduce the burden of STH and Schistosoma infections. Information for this review came from a comprehensive search of titles related to intestinal helminthiasis in Ethiopia using PUBMED and other bibliographic databases conducted between July and September 2017, using the key words "Ethiopia", "intestinal helminthiasis", "soil-transmitted helminths", "epidemiologic trends", "school children", "chemotherapy" and "school-based control". We searched on any nature of studies but restricted on English language. To identify additional studies, reference lists of publications were carefully screened. Initial assessment was based on review of title and abstract of all the studies. Full text of potentially relevant studies was further analyzed. Further searches were conducted based on links from the articles cited but limited to publications from 2000 to 2017. Relevant websites such as that of WHO and Ethiopian Federal Ministry of Health were also searched.

## RESULTS

Initial searches identified 175 studies from PubMed and relevant sites. After removing duplicates and irrelevant articles 97 studies were considered for full text review. Studies were excluded for not reporting a prevalence data of at least three parasites in schoolchildren and not reported in the study time range (50), lack of full text availability (7) and incomplete data (10). Two studies were excluded as they reported data from the same geographical area; in each case only recently conducted study was considered. A total of 28 studies were identified that reported the prevalence of more than three IHs among schoolchildren in Ethiopia (Fig. 1).

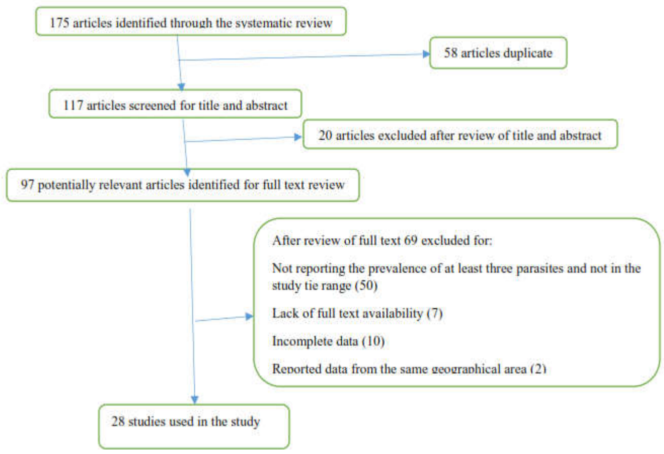


**Fig. 1. Schematic representation of the study selection process**

All 28 studies were cross sectional in nature. Most of the reported data were from Oromia, Amhara, Tigray, SPNN, and BGRS of Ethiopia, with a general lack of publication from Dire Dawa, Ethiopian Somali, Addis Ababa, Afar, Harere and Gambella regions of Ethiopia. Smallest sample size was 261and largest sample size was 800. A total of 12,688 stool samples were screened for the presence of intestinal helminthic infection. A combination of Saline and iodine wet mount, Kato-Katz technique and formolether concentration techniques were used for parasite detection (Table 1).

**Table 1. Prevalence estimates of intestinal helminthic infections in Ethiopia, 2000-2017**

| Reference | Study area | Sample size | Area of residence | Predominant IP (Prevalence (%)) | Risk factors (P<0.05) /needed efforts |
|---|---|---|---|---|---|
| Gelaw*et al*., 2013 (10) | Gonder, Amhara state | 304 | Urban | Hn (13.8%)<br>Al (5.9%)<br>Tt (3.2%) | Hand washing practice, movement with bare foot/ Health education |
| Kidane*et al*., 2014 (11) | Wukro, Tigray state | 384 | Urban | Al (5.7%)<br>Hw (3.9%)<br>Tt (3.1%) | Family size, source of water and its handling, availability of latrines/ Safe water supply |
| Workneh*et al*., 2014 (12) | Debre Elias, Amhara state | 541 | Rural | Hw (71.2%)<br>Ss (2.4%)<br>Hn (1.9 %) | Unavailability of safe water supply, absence of shoe wore during interview, educational grade level/Health education |
| Alamir*et al.*, 2013 (13) | Dagi, Amhara state | 439 | Rural | Hw (23.6%)<br>Al (8.3%)<br>Ev (7%) | Fathers' occupational status, unclean finger nails and who did not have the habit of wearing shoes / Health education |
| Legesse and Erko, 2004 (14) | Kime and Langano, Oromia state | 259 | Rural | Hw (60.2%)<br>Sm (21.2%)<br>Tt (14.7%) | No risk factor reported /Institution based intervention measures |
| Tadesse, 2005 (15) | Babile, Ethiopian Oromia state | 415 | Urban | Hn (10.1%)<br>Hw (6.7%)<br>Sm (4.3%) | Poor personal hygiene moving regularly with bare foot, eating food items sold on the street/ Health education |
| Ayalew*et al.,* 2011 (16) | Delgi, Amhara state | 704 | Urban | Al (48%)<br>Sm (15.9%)<br>Hw (11.5%) | Less educated mother, drinking unprotected well/spring water no hand washing practice before meal/ Health education and safe water supply |
| Mathewos*et al.,* 2014 (17) | Gorgora and Chuahit, Amhara state | 261 | Urban | Al (39.8%)<br>Tt (6.1%)<br>Hw (4.9%) | Swimming habit/ Implementation of an integrated strategy to control |
| Haftu*et al*., 2014 (18) | Arba Minch,SPNN state | 498 | Urban | Al (10.6%)<br>Hn (4.2%)<br>Hw (2.2%) | Hand washing practice before meal, nail hygiene, and children's mother educational level/ Health education |
| Dejene and Asmelash, 2008 (19) | Hintallo-Wejerat, Tigray state | 800 | Rural | Hn (11.4%)<br>Hw (4.3%)<br>Sm (2.6%) | Increased irrigation practices/ Health education |
| Dejene and Asmelash, 2010 (20) | Around Mekelle, Tigray state | 622 | Rural | Al (10.45%)<br>Ev (8.52%)<br>Sm (5.95%) | Proper management of the water and the canal system/ Health education |
| Jejaw*et al.*, 2015 (21) | Mizan-Aman , SPNN state | 460 | Rural | Sm (44.8 %)<br>Al (28.7 %)<br>Tt (18.7 %) | No reported risk factor /Deworming, improvement of hygienic practice |
| Endris *et al*., 2010 (22) | Azezo, Amhara state | 354 | Town | Sm (43.5%)<br>Al (28.8%)<br>Tt (18.1%) | Poor personal hygiene, lack of protective shoe, frequent swimming habits/ Health education |
| Gebreslassie *et al.,* 2015 (23) | Abreha-Weatsibeha, Tigray state | 404 | Urban | Al (9.4%)<br>Hn (6.2%)<br>Hw (2.7%), | Low household income, absence of hand washing habit with soap after defecation and habit of eating raw unwashed vegetables/ Health education |
| Maru, 2017 (24) | Adigrat, Tigray state | 309 | Urban | Al (19.1%)<br>Hw(10.03%)<br>Ss(7.77%) | Practice of fingernail trim, unprotected well water source and living in rural area education on personal hygiene and environmental sanitation, water supply and continuous treatment |

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| | | | | | |
|---|---|---|---|---|---|
| Abera and Nibret, 2014 (25) | Tilili, Amhara state | 385 | Urban | Al (39.7%)<br>Tt (7.8%).<br>Hw (5.45%) | Not wearing shoes regularly/ Intervention programs and Health education on personal and environmental hygiene |
| Taye, 2014 (26) | WonjiShoa town, Oromia state | 669 | Urban | Sm (28.3%)<br>Al (15.2%)<br>Hw (12.1%) | No risk factor reported/Mass treatment, snail control health education |
| Gebretsadik,2016 (27) | Homesha, BGRS | 404 | Rural | Hw (10.12%)<br>Ev (5.56%)<br>Ts (2.02%) | Improper waste disposal, eating unwashed/undercooked vegetation, and moving with bare foot/Public education program |
| Legesse*et al.,* 2010 (28) | Adwa, Tigray state | 386 | Urban | Sm (63%)<br>Al (6.4)<br>Hw (1%) | Swimming habit, crossing streams/ Chemotherapy, environmental sanitation, health education |
| Alemayehu*et al*., 2017 (29) | Wolaita Zone, SPNN | 515 | Rural | Sm (58.6%)<br>Hw (27.6%)<br>Al (8.7%) | Swimming in rivers and streams / Snail control, chemotherapy, sanitation, provision of clean water supply, |
| Hailegebriel, 2017 (30) | Bahir Dar, Amhara state | 359 | Urban | Hw (22.8%)<br>Al (13.6%)<br>Hn(4.7) | Irregular shoe wearing habit/Quality of water sources, health education,environmental sanitation, |
| Tulu *et a*l., 2014 (31) | Yadot primary school, Bale Zone, Oromia state | 340 | Urban | Sm (12.6)<br>Al (4.7)<br>Hn(4.4) | Not knowing why they wash their hands before meal, water contact activities, not wearing protective shoe/ Health education, provision of safe drinking water, improving sanitation, increasing latrine use, snail control, deworming |
| Abossie and Seid, 2014 (32) | Chencha town, GamoGofa Zone, SPNN | 422 | Urban | Al (60.5%)<br>Tt (9.7%)<br>Ts (0.75%) | Educational status of the household heads, absence of washing facility, home cleanness condition and type of latrine used/ Multiple intervention strategies should be implemented |
| Tefera *et al*., 2015 (33) | Babile town, Oromia state | 644 | Urban | Hn (13%)<br>Ev (0.6%)<br>Hw (0.3 %) | Grade, sex, health information dissemination/ Provision of regular deworming |
| Jemaneh, 2001 (34) | Chilga District, Amhara state | 687 | Rural | Al (42.9%)<br>Hw (37.7%)<br>Sm (19.4%) | No reported risk factors/Provision of safe water supply, latrine construction, and health education, periodic deworming |
| Abdi *et al*., 2017 (35) | ZegiePeninsula, Amhara state | 408 | Rural | Hw (43.4%)<br>Sm (29.9%)<br>Al (12.7%) | Habit of wearing shoes, swimming,and hand washing before meals/ Health education, snail control |
| Alemu*et al.,* 2011 (36) | Zarima town, Amhara state | 319 | Urban | Al (22%)<br>Hw (19%)<br>Tt (2.5%) | Shoe wearing and swimming habit, provision of safe and adequate water supply, latrine construction/ Health education, periodic deworming |
| Amor *et al*., 2016 (37) | Rural area of Bahir Dar,Amhara state | 396 | Rural | Hw (54.5%)<br>Ss (20.7%)<br>Sm (15.7%) | No reported risk factors/ Applying a comprehensive diagnostic approach |

SPNN= Southern people nation and nationalities, BGRS= Benishangul Gumuz regional state,Sm = *Schistosoma mansoni,* Hw = *Hookworm,*Al = *Ascarislumbricoides,* Tt = *Trichuristrichiura,* Ev = *Enterbiusvermicularis,* Hn= *Hymenolepis nana,*Ss = *Strongyloidesstercolaris,*Ts=*Tania saginata,*

The reports on prevalence of intestinal helminths among schoolchildren, identified intestinal helminths, associated risk factors varied across the country. However, the needed efforts are almost similar in every study area with slight difference. Form the 28 research articles, 22, 21 and 14 research findings reported Hook worm, *A. lumbricoides*, and *S. mansoni*as one of the three most common parasites in the study area respectively. Both *T. trichiura* and *H. nana* reported from 9 different locations as one of the three most common IHs.

A higher than 20% prevalence for Hook worm *A. lumbricoides*and *S. mansoni*was reported from 8 different locations scattered across Amhara regional state and SPNN regional state. And *S. mansoni* was reported from 7 different locations scattered across Amhara, Tigray, Oromia and SPNN regional states. A higher than 20% prevalence for *S. stercolaris* was also reported from rural area of Bahir Dar, Amhara state. The other parasitessuch as *T. trichiura, E. vermicularis, H. nana* and*T. Saginata* were not reported to cause higher than 20% prevalence (Table 1).

# DISCUSSION

Despite efforts to educate the population with health extension workers, mass deworming program and improvement in water quality and sanitation, intestinal helminthiasis are still prevalent in Ethiopia. A conducive climate for their growth, rapid and unplanned urbanization, social practices of open defecation and lack of community education and sanitation are some of the factors, which impedes control of infection in Ethiopia. This information has the potential to inform and develop a comprehensive approach to control intestinal helminthiasis and target highly endemic areas with greater urgency. The present study was to assess the burden of intestinal helminthiasis by searching past and present published literature and analyzing the most prevalent intestinal helminths such as *Ascarislumbricoides*, *Trichuristrichiura*, Hookworms, *H. nana, E. vermicularis*and *S. mansoni* in one of the most endemic country in the world. The study covered almost 17 years of published literature on the topic of intestinal helminthiasis among schoolchildren covering 5 out of the 11 Ethiopian regional states. This study is another step in the direction of understanding prevalence and geographical distribution of intestinal helminthiasis that affects nearly all population living in Ethiopia. The most important factors affecting the survival and spread of intestinal helminthiasis among schoolchildren are: sanitation, socio-economic status, lake of awareness on the transmission parasites, presence of conducive environment for vectors (snails) and tropical climate with high humidity and warm temperatures. Theses climatic conditions provide ideal environment for the survival of parasite eggs in moist soils.

### *Epidemiology of Intestinal helminthic infections in Ethiopia*

Epidemiological studies carried out indifferent countries have shown that the situation of an individual is an important cause in the prevalence of intestinal parasitic infection, having a greater rate in school children (Ayalew *et al.*, 2011). The reviewed papers reported that the triad of Hookworms, *Ascarislumbricoides*, *S. mansoni, Trichuristrichiura*, *H. nana* and *E. vermicularis* were common intestinal helminthicinfections in Ethiopia (Table 1). It has been reported that helminthic parasites such as*Ascaris, Trichuristrichiura*, Hookworms were the most predominant parasites in developing countries including Ethiopia (Haque, 2007; WHO, 2012, Samuel, 2015). However, *S. mansoni, H. nana* and *E. vermicularis* were also found to be the most predominant intestinal helminthesin some parts of Ethiopia (Gelaw *et al.*, 2013; Taye, 2014). In this this review, the prevalence rate of *A. lumbricoides* was found to be higher among the predominant intestinal helminthic species in the studies conducted in Wukro (Kidane *et al.*, 2014), Adigrat (Maru, 2017), Tilili (Abera and Nibret, 2014), Primary school found around Mekelle (Dejene and Asmelash, 2010). They also reported that environmental sanitation and personal hygiene of study subjects probably play an important role for the higher prevalence rate of Ascariasis. In this review, the prevalence rate of Hook wormswas found to be higher among the predominant intestinal helminthic species in the studies conducted in Debre Elias (Workneh *et al.*, 2014) and Homesha (Gebretsadik, 2016). The reason might be the geography of the place or the socio economic condition of the study area and the habit of the study participants in relation to shoe wearing (Workneh *et al.*, 2014; Gebretsadik, 2016).Moreover, occupation probably has a greater influence on hookworm epidemiology. Engagement in agricultural pursuits remains a common denominator for human hookworm infection (Samuel, 2015).

## Risk Factors Associated with Intestinal Helminthiasis

### *Sociodemographic factors*

Sociodemographic factors such as sex, age, grade level of schoolchildren, family income and educational status influence the prevalence and intensity of intestinal helminthinfections. The study conducted in Zarima town (Alemu *et al.*, 2011), Dagi primary school (Alamir*et al.*, 2013), in Tilili town (Abera *et al.*, 2014) in Homesha district (Gebretsadik, 2016) reported that children under $4^{th}$ grade and students with lower agehad a higher prevalence of intestinal helminthic infections than those in grades four to eight. The possible explanation might be the level of awareness about washing hands, in children whose grade become (1-4) was lower than those whose grade become 5-8. They frequently involve themselves fully in activities that bring them in contact with the source of infection. This causes passing viable ova to one another when they use dirty hands to share foods in STH (Tadese, 2005; Abera *et al*., 2014; Haftu*et al.,* 2014). The other reason might be those students whose grade from 1 to 4 was less immunized compared to grade 5 to 8 (Werkneh *et al.*, 2014, Gebretsadik, 2016). On the other hand, there was no significant difference in the rate of infection due to helminths in relation to the age of students. This might be due to different evasion mechanisms to immunity by helminths (Gelaw *et al*., 2013).

In Ethiopia, there are contradicting reports about the association of intestinal parasites and sex, with exceptional consistent gender-associated difference in the case of intestinal schistosomiasis. The study done in Azezo (Endris *et al.*, 2010), around Mekelle (Dejenie and Asmelash, 2010), WonjiShoa (Taye, 2014), reported that the overall intestinal parasitic infection was significantly higher in males than females ($P<0.05$). In contrary to this, the study done in Homesha district (Gebretsadik, 2016), Adigrat (Maru, 2017), reported that the overall intestinal parasitic infection was significantly higher in females than males ($P<0.05$). This is so because female children are more actively involved in carrying out activities in and out of their immediate environment thereby exposing them to infection (Gebretsadik, 2016; Maru, 2017). Other studies reported that there was no statistically significant association between parasite prevalence and being male and female (Haftu *et al.,* 2014; Mathewos *et al*., 2014). The study done in Azezo (Endris *et al.*, 2010), around Mekelle (Dejenie and Asmelash, 2010) reported the prevalence of *S. mansoni* infection significantly higher in boys than in girls ($p<0.05$).This variation in infection is associated mainly to division of work in different communities and ethnic groups (Dejenie and Asmelash, 2010). Swimming habit (OR: 2.536, 95% CI: 1.122, 5.737, P = 0.022) was also significantly associated with *S. mansoni* infection (Mathewos *et al.*, 2014).The study done in Delgi school children (Ayalew *et al.*, 2011), in Arba Minch (Haftu *et al.,* 2014) reported that the overall intestinal parasitic infection was significantly higher in children who have illiterate mothers (Odds Ratio 2.14; 95% CI 1.27 to 3.63) and family with low house hold income and children who had habit of eating raw/unwashed vegetables (Gebreslassie *et al.,* 2015). This is more likely that parents of children at high level of education provide better sanitation condition for their children than low educational level parents (Ayalew *et al*., 2011).

***Behavioral and sanitary habits***

Soil-transmitted helminths depend for transmission on environments contaminated with egg-carrying feces. Consequently, helminths are intimately associated with poverty, poor sanitation, and lack of clean water. One of the significantly associated factor for IH was source of water supply. Students who consume spring/pond water and river water were likely to be exposed to parasitic infection compared to those who consume pipe water (Ayalew *et al*., 2011; Werkneh *et al.*, 2014). This might predisposes to children for different types of water borne parasites. The possible reason could be contaminated water with animal and human waste could be entered in to the river or unprotected spring/pond (Ayalew *et al*., 2011; Werkneh *et al*., 2014). The provision of safe water and improved sanitation are essential for the control of helminth infection (Samuel, 2015). Shoe wearing habit is significantly associated risk factor with IH and school children who do not wear shoe are more likely to be exposed to parasitic helminthes than those school wear shoe (Werkneh *et al*., 2014). This is probably those students who do not wear shoe might be infected by soil transmitted helminthes through intact bare foot penetration (Tadese, 2005; Werkneh *et al.*, 2014).

The prevalence of IHs in school children of rural residents was higher as compared to urban resident students (Maru, 2017). This is due to improved environmental sanitation, regular wearing of shoes and better family income (Gelaw *et al*., 2013, Maru, 2017). The study done in Babile (Tadese, 2005), in Azezo (Endris *et al.*, 2010), in Delgi school children (Ayalew *et al*., 2011), in University of Gondar Community School (Gelaw *et al*., 2013), in Arba Minch (Haftu *et al.,* 2014) in Aksum(Gebreslassie *et al.,* 2015) reported that intestinal parasitic infection was significantly associated with hand washing and IH are higher in children who do not practice hand washing before eating. Moreover, studies conducted in Arba Minch (Haftu *et al.,* 2014), in Babile (Tadese, 2005) reported that children who had dirty materials in their fingers and trim their finger nails (Maru, 2017) were more likely to acquire intestinal parasites infection. This is probably due to low knowledge of children about the feco-oral transmission of intestinal parasite through their unwashed hands. The other factor that exposed children for intestinal parasite infection identified in this study was eating of unwashed/uncooked vegetables. The reason might be due to the contamination of vegetables with fecal materials in the farm (Ayalew *et al*., 2011).Although the STHinfections are neglected diseases that occur predominantly inrural areas, the social and environmental conditions in manyunplanned slums and squatter settlements of developing countries are ideal for the persistence of *A. lumbricoides* (Ekundayo *et al*., 2007). *Ascaris* and *Trichuris* commonly occur both in urban environments, especially urban slums, and in rural areas. Insome instances the prevalence of *Ascaris* infection is actually greater in urban environments. In contrast,high rates of hookworm infection are typically restricted toareas where rural poverty predominates (Brooker *et al.,* 2010). The urban-rural dichotomy between *Ascaris-Trichuris*versus hookworm can be partly understood by fundamental differences in the life cycles of these soil-transmittedhelminths. The infective stages of *Ascaris-Trichuris* areembryonated eggs having enormous capacity forwithstanding the environmental extremes of urban environments. Contained within the inner layer of *Ascaris* eggs is an unsaponifiable lipid known as ascaroside, which confers many of its hardy properties. In addition toascaroside, *Ascaris*eggs are coated with amucopolysacccharide that renders them adhesive to a wide variety of environmental surfaces. This feature accounts fortheir adhesiveness to everything from door handles, dust, fruits and vegetables, paper money and coins, etc. Transmission through the ingestion of *Ascaris* eggsadhering to vegetables is a major route of transmission (Schmidt and Roberts, 2009). *S. mansoni*infection transmission was also associated with lake of awareness on the role of snails on intestinal transmission.

## Control and Prevention of IH

Current efforts to control STH infection, as well as schistosomiasis, focus on the school age population (Brooker *et al.*, 2006). In 2001, the World Health Assembly set a goal of attaining a minimum target of regular administration of chemotherapy to at least 75% and up to 100% of all school-age children at risk of morbidity by 2010 (Bethony *et al*., 2006). To achieve this global target, the WHO advocated a partnership for parasite control, involving organizations of the United Nations system, bilateral agencies, non-governmental organizations, and the private sector. Helminthic infections, neglected in the past, are now back on the public health agenda and their control will have a lasting impact on the health of children in endemic countries (Hotez *et al*., 2009). Ethiopian children certainly stand to benefit from this renewed interest in helminthic infection control. It is particularly noteworthy that school-based helminth control programs have been shown to be practicable and well-received at the community level in Ethiopia. The majority of the country has a clear need for school-based MDA. The main gaps for both schistosomiasis and STH are lack of supplies (drugs), coordination and collaboration between partners, lack of a nationwide disease distribution and prevalence map and lack of public awareness and advocacy (MoH, 2013). Even after solving these challenges, controlling both schistosomiasis and STH with School-based MDA only cannot be achieved. Thus, it must be supplemented with provision of safe water supply, proper usage of latrine, vector control and health education. Generally, integrated intervention strategy should be done in parallel to deworming programs.

## Conclusion

Intestinal helminth infections are still highly prevalent among schoolchildren in Ethiopia and a major cause of morbidity in this age group. The study showed Hookworm, *A. lumbricoides*, and *S. mansoni* were one of the three most common IHs among schoolchildren in Ethiopia. Poor personal and environmental hygiene, poverty, illiteracy, lack of awareness on transmission and prevention of IHs and favorable climatic conditions are major reported risk factors sustaining transmission of intestinal helminth infections.

Recently there has been policy-backed effort in school based control. The effectiveness of school-based intervention using chemotherapy at six monthly intervals has been demonstrated to be cost-effective and feasible, in Ethiopia and elsewhere. The time is ripe for policy makers in Ethiopia to grab the opportunity that school-based programs offer and relieve Ethiopian children of the burden of intestinal helminthic infection, so that they can achieve their maximum potential. Furthermore, lack of studies from several parts of Ethiopia requires urgent attention for the surveillance and prevalence determination of intestinal helminthic infection. An exhaustive knowledge of the burden of disease will be helpful in allocating resources, funding and designing survey strategies for the control and monitoring of intestinal helminthic infection in Ethiopia.

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