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Prevalence and Intensity of Intestinal Parasitic Protozoan and Soil-Transmitted Helminth Infections of School Children in Alemketema Town, Central Ethiopia

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Abstract:
A cross-sectional epidemiological investigation involving a sample population of 384 school children from grade one to grade eight in the two selected primary schools located in the Alemketema Town during May-June, 2010. A total of 384 stool samples of school-children were examined using Direct Wet-mount and Formalin-Ether concentration technique on fresh collected feces. The overall prevalence of intestinal parasitic infection was 46.1% (25% of males and 21.1% of females). The prevalence of protozoan parasites, E. histolytica and G. lamblia was 16.4% and 6%, respectively. Similarly, the prevalence of soil-transmitted helminth infections for A. lumbricoides, H. nana, Hookworms and S. stercoralis was 8.1%, 7.3%, 0.8% and 0.5%, respectively. Anthropometric indices of the pupils were measured and the relationship with the prevalence and intensity of intestinal parasitic infection were analyzed. But, there was no relationship between the anthropometric indices and prevalence of intestinal parasitic infection. In summary, intestinal parasitic protozoan infections represent a public health problem in the school-children of Alemketema town. However, a longitudinal study is required on the prevalence of intestinal parasitic infections and other blood protozoan parasites like malaria in the study area

Keywords: *Prevalence, Intensity, Protozoa, Helminth, Anthropometry, School children, Alemketema*

1. Introduction

Human intestinal parasites are identified as causes of morbidity and mortality throughout the world particularly in underdeveloped countries [12]. A high prevalence of intestinal parasitic infections in human is positively correlated with poverty and poor environmental hygiene, lack of safe water supply, contamination of the environment by human excreta and animal wastes, poor environmental sanitation, poor personal hygiene and living condition [18].

The intestinal parasites frequently encountered in humans especially in tropical and sub-tropical countries include round worm, *Ascaris lumbricoides*; hookworms, *Necator americanus* and *Ancylostoma duodenale*; whipworm, *Trichuris trichiura* and *Schistosoma* species (bilharzias) and protozoan parasites, *Entamoeba histolytica* and *Giardia lamblia* [9]. Those parasitic helminths such as round worm, hookworms, whipworm and *Schistosoma* species (bilharzias) *are* referred to as worms, and except *Schistosoma* species all the four nematodes of humans are referred to as soil-transmitted helminths (STHs) or geohelminths [2].

School children in many developing countries including Ethiopia harbor the most intense infections with those intestinal protozoan parasites and helminth [38]. Infants, toddlers and other young children are reported to be most vulnerable to the adverse nutritional effects of intestinal parasitic infections. One reason is that they often suffer from an increased intestinal parasitic infection burden associated with a greater exposure to those infectious agents by virtue of unsanitary practice associated with child development e.g. playing in contaminated dirt and water, sucking on dirty finger and other objects [33].

Though the prevalence and intensity of intestinal parasitic infections in many countries reach a peak in the school group, in addition to this they are also known to have devastating effects on older children resulting in nutritional deficiency, intestinal obstruction, prostrating anemia, chronic dysentery, rectal prolapse, respiratory complications, poor weight gain, retarded growth and mental retardation [5]. Their less mature immune system especially in those aged < 6 years can reduce their ability to mount strong immune defense to infectious agents. Thus, they are more likely to suffer from the adverse consequence of infection, which can affect energy and nutrition intake, transport, metabolism and excretion [7].

Therefore, it is very crucial to know the prevalence of intestinal parasitic infections even though there is no published information in the study area about the prevalence of infection.

1.1. Objective

The objective of this study was to assess prevalence and intensity of human intestinal parasitic protozoan and soil-transmitted helminth infections among school children of Alemketema Town, Central Ethiopia.

2. Materials and Methods

This cross sectional survey of intestinal parasitic infections was conducted among 384 school children of Alemketema town, central Ethiopia. The town is located 182 kms from Addis Ababa. Prevalence of intestinal parasitic infections and intensity of soil-transmitted helminth of school children in the study area as well as the association of prevalence and infection load with anthropometric indices of school children were determined. The parasitological survey was conducted during the short dry season (May-June 2010).

2.1. Stool Sample Collection

Disposable plastic cups and spoon were distributed to each study subject along with brief instructions on how to collect the stool. They were also advised to fill up the disposable plastic cup about the size of the tip of the thumb (approximately 10g of stool) of fresh stool using disposable spoon that was given with the container. The unique code of the student was labeled on the container. The stool samples were carried to the Alemketema Enat hospital on the same day of collection for parasitological examination and enumeration.

2.2. The Anthropometric Indices

Weight of the study subjects was measured using a standing scale and the height was measured using a paper stadiometer attached to a straight stick. The anthropometric indices were categorized into BMI, Wasting, stunting and underweight as per the guidelines of the WHO and Wasting, stunting and underweight were defined as Z score values of less than –2 SD (Standard Deviation), which was below the expected on the basis of the international growth reference scale [31].

2.3. Laboratory Parasitological Examination Procedures

Stool samples were diagnosed for the presence of intestinal parasites using direct wet-mount and formalin-ether concentration methods. In Formalin-ether concentration technique, formalin and ethyl acetate were used to remove lipids and subjected to the filtration and centrifugation to concentrate the ova or cysts in the sample. Identification of the parasite species was done on the basis of morphology and size by the principal investigator assisted by experienced laboratory technicians and referring the parasitological laboratory manual [8].

2.4. Data Analysis

The collected data were analyzed using SPSS version 13 Software. Wasting, stunting and underweight were defined as Z score values of less than –2 SD (Standard Deviation), which were below what was expected on the basis of the international growth reference scale [13]. The differences were considered significant when the p value was less than 0.05.

2.5. Ethical Consideration

This study was presented and approved by the Research and Ethics Committee of the Haramaya University. All the specimen collection was done using sterile and disposable materials. Individuals diagnosed positive for intestinal parasitic protozoa and helminth infections were treated free of charge with appropriate anti parasitic drugs by health personnel.

3. Result and Discussion

3.1. Prevalence of Intestinal Parasitic Infections among School-Children of Alemketema Town, 2010

The type of protozoan and soil-transmitted helminth parasites identified in the stool sample of the school-children are presented in Table 3. The result of parasitological investigations showed that, 177 of 384 specimens of the school-children, (46.1%) were positive for one or more intestinal parasites. Of these infected pupils, 25% (96 cases) and 21.1% (81 cases) were males and females, respectively. *E. histolytica* and *Giardia lamblia* were the major protozoan parasites identified from the school- children with the prevalence of 16.4% and 6%, respectively.

Amoebic dysentery due to *E. histolytica* infection is the second most common cause of death in the world after malaria among intestinal protozoan parasites [37]. According to the finding done by Yeneneh [42], the prevalence of intestinal parasite infections was 82.7% in residents of 4 villages in Southwestern Ethiopia. Similar studies done by Mengistu and Berhanu Erko on the school children in Lake Langano showed that the prevalence of intestinal parasitic infections was 60.2%. Another study conducted by Legesse and Erko, (2004) among school-children around Lake Langano also reported that the prevalence of intestinal parasitic protozoan was 83.8%. This result was higher than another school-based study done in Jimma by Haile *et al,* (1994) who reported the prevalence of 68.4%. Similarly, the prevalence of amoebiasis and giardiasis in Southwest Ethiopia was also 3.1% and 3.6%, respectively [3].

Until relatively recently, the nonpathogenic *E. disper* was not always differentiated from *E. histolytica* with a direct wet mount and concentration techniques [35]. Trophozoites of protozoan parasites were more readily identified from specimens examined immediately after they were passed or preserved at the time of direct wet mount techniques. They were not found in specimens examined by means of a concentration technique. The examination of additional stool specimens from each study subject would almost certainly have resulted in higher percentages of parasites isolated.

Therefore, the three potential protozoan species (including *E. disper*) in the present study was 22.4 % of those surveyed, among 384 school-children of Alemketema town. Thus, a higher prevalence of *E. histolytica* which was found among school-children might include the prevalence of *E. disper* as compared with *G. lamblia*.

Similarly, the major soil-transmitted helminth parasites identified in the stool samples of the school- children were *A. lumbricoides, H.*

nana, Hookworm and *S. stercoralis* with the prevalence of 8.1%, 7.3%, 0.8% and 0.5%, respectively. These four helminth parasites were found with an overall prevalence of 16.7%. Out of the overall prevalence of helminth parasites, 17.7% and 15.6% of positive cases were males and females, respectively except the case of Hookworm infections occur only in female pupils.

A. lumbricoides, Hookworm and *T. trichiura* are the most prevalent helminth parasites worldwide [38]. In the present study, *A. lumbricoides* and *H. nana* were found to be the major prevalent intestinal helminth parasites of the school-children in the study area. Similar study done on the prevalence of *A. lumbricoides* in Jimma by Worku and Solomon (2007) reported that, the prevalence of *A. lumbricoides* was 37.3% and an overall prevalence for five geohelminth ova (*A. lumbricoides, E. vermicularis, T. trichiura, S. stercoralis* and Hookworm) was 41.5%.

In addition to this, the prevalence of Hookworm infections was lower among the school-children of Alemketema town with the prevalence of 0.8%. Another study done from Southern Ethiopia by Ibrahim *et al* (1999) reported that, Hookworm, *A. lumbricoides* and *T. trichiuria* infections with the prevalence of 25.5%, 56.4% and 21.6%, respectively. Similarly, Belay and Solomon reported a higher prevalence of Hookworm (17%), *A. lumbricoides* (75.2%) and *T. trichiuria* (24.4%). There were no *T. trichiuria* infections in Alemketema town school-children.

The prevalence of *H. nana* in the school-children of Alemketema town was 7.3%. This was higher than the findings of Belay and Solomon (1998) with the prevalence of 1.1%, Tsehai *et al* with 1.3% and Lo *et al*, (1989), with 2.8% prevalence, but five times lower than with the finding done among school children of Kemise town in Northern Ethiopia with 61% of prevalence of *H. nana* [21].

Regarding the number of intestinal parasite infections per individual, more than one parasite was found in the study subjects. Multiple infections were seen in 27 (7%) cases of the total examined sample of 384 specimens of the school-children with intestinal (two protozoan), (protozoa and helminth) and (two helminth) parasites with the prevalence of 2.6% (10 cases), 3.6% (14 cases) and 0.8% (3 cases), respectively. The study done from Southern part of Ethiopia showed, higher overall prevalence of intestinal parasitic infections (89%) and the prevalence of multiple infections was 35.4%, which was higher than those found by Roma and Worku, (1997). The prevalence of multiple infection observed by Lo *et al.,* (1989) from Eastern Ethiopian region was 45.9% and higher than the study done by Roma and Worku, (1997). In relation with this, the school-children of Alemketema town showed lower prevalence of multiple infections than the works done earlier in other parts of Ethiopia [25, 32].

Parasites species	**Male(n=192)**		**Female(n=192)**		**Both Sex No. positives (%)**	
	No. positives [b]	%	No. positives	%		
Protozoan parasites						
E. histolytica	33	17.2	30	15.6	63(16.4)	0.9
G. lamblia	10	5.2	13	6.8	23(6)	0.4
Any protozoan [a]	43	22.4	43	22.4	86(22.4)	-
Helminths						
A. lumbricoides	16	8.3	15	7.8	31(8.1)	0.2
Hookworm	0	0	3	1.6	3(0.8)	0.3
S. stercoralis	1	0.5	1	0.5	2(0.5)	0
H. nana	17	8.9	11	5.7	28(7.2)	0.3
Any helminths	34	17.7	30	15.6	64(16.7)	-
Multiple infections [c]	19	9.9	8	4.2	27(7)	-
Any parasites [d]	96	25	81	21.1	177(46.1)	0.8

Table 1: Prevalence of Human Intestinal Parasitic Infections by Sex among School-Children of Alemketema Town Primary Schools, 2010

a: - Either *E. histolytica* or *G. lamblia*
b: - Is to mean that positive for any intestinal parasites (protozoan (*E. histolytica* or *G. lamblia*) and STHs
c: - Infection with two or more protozoan and/or helminth parasites
d: - Any intestinal protozoan or helminth parasites

The results of the prevalence of intestinal parasitic infections among the primary school-children of Alemketema town with in the age group of the study subjects are summarized and presented in Table 2. The age of the sample population is divided in to three groups: 5-10 years, 11-15 years and ≥16 years. After screening of 384 study subjects, the overall prevalence of intestinal parasitic infection among all age group of the pupils in both schools was 46.1%. Of these, the prevalence of any intestinal parasitic infections for the age group of 5-10, 11-15 and ≥16 year were 49%, 43.4% and 50%, respectively. The higher overall prevalence of intestinal parasitic infection was seen in the age group of ≥16 years than other group which indicating a higher risk for acquiring parasitic infections.

The prevalence of the two intestinal protozoan parasites among the three age groups of the student was 20%, 23.1% and 30.8% for 5-10, 11-15 and ≥16 years, respectively. Higher prevalence of protozoan parasites was observed in the age group of ≥16 years (30.8%). There was a slight increment in the prevalence of protozoan infection with the higher age group of the students. From the two protozoan parasites, the prevalence of *E. histolytica* was higher in the school-children of 11-15 years of age than adults greater than 14 years of age.

Generally, the prevalence of parasitic infections was higher in the age group of ≥16 years (50%) and in the lower aged school children. This is because younger people have lower resistance to parasitic infections as compared to adults since many of the defense systems are not fully developed in children. In addition to this, children are more exposed to overcrowded conditions (schools, nurseries, playgrounds etc). Higher prevalence of parasitic infections among school-children may occur due to the poor sanitary conditions in the schools [28]. Children usually do not take care of their personal hygiene, such as playing in contaminated outdoor environments, in and around disposal sites (which can certainly cause serious health problems), absence of latrine and lack of basic life skills, such as washing hands before and after meals [1]. Educational level of the parent of the children is also an important factor influencing the prevalence of parasitic infection [26].

Parasites species	5-10 Yrs(n=155)		11-15 Yrs(n=203)		>16 Yrs(n=26)				
	No. positives	%	No. positives	%	No. positive	%	All age group (%)	X^2	P-value
Protozoan parasites									
E. histolytica	22	14.2	35	17.2	6	23.1	16.4	0.8	0.5
G. lamblia	9	5.8	12	5.9	2	7.7	6	0.05	0.9
Any protozoan	31	20	47	23.1	8	30.8	22.4	-	-
Helminths									
A. lubricoides	16	10.3	14	6.9	1	3.8	8.1	0.7	0.4
Hookworm	0	0	2	0.9	1	3.8	0.8	2.16	0.1
T. trchiuria	0	0	0	0	0	0	0	-	-
S. stercoralis	2	1.3	0	0	0	0	0.5	1.4	0.2
H. nana	14	9	14	6.9	0	0	7.3	1.2	0.2
Any helminths	32	20.6	30	14.7	2	7.6	16.7	-	-
Multiple infections	13	8.34	11	5.4	3	11.5	7.03	0.05	0.9
Any parasites	76	49	88	43.4	13	50	177(46.1)	-	-

Table 2: Prevalence of Human Intestinal Parasitic Infections by Age among School-Children of Alemketema Town Primary Schools, 2010.

An overall prevalence of soil-transmitted helminth infections in the studied pupils was 16.7% (64 cases of the total stool specimens). The total prevalence of the four helminth parasites among the age groups of 5-10, 11-15 and ≥16 years was 20.6%, 14.7% and 7.7, respectively (Table 2). The higher prevalence of helminth infections was recorded in the age group of 5-10 years. This age group of the student was highly infected with intestinal parasites because they are an active age group in which they like playing underground and they get easily contaminated with soil.

Similar study done by Solomon (2006) in Welayta Zone, Southern Ethiopia has reported 35.9% prevalence of helminth infections among school-children. The major helminth parasites identified during this study were Hookworm, *A. lumbricoides* and *T. trichiuria* with the prevalence of 25.6%, 12.3% and 10.5%, respectively [34]. Multiple infections were observed in 10.2% of the positive cases. According to his report, the prevalence of

Hookworm infections was significantly higher ($P< 0.001$) in the age group 14 years and above than younger age groups. Similarly, in his study the prevalence of *A. lumbricoides* and *T. trichuria* infections were significantly higher ($P < 0.001$) in 6 - 14 years than other age groups. On the other hand, the prevalence of Hookworm, *A. lumbricoides* and *T. trichiura* infections were not significantly different in both sexes ($P< 0.001$).

In the present study *A. lumbricoides* and *H. nana* were detected with a higher prevalence in children aged below 10. In general, the prevalence of soil-transmitted helminth infections tends to decreased as the age of the student increase. This is due to, children lower than 10 years old have a higher risk of infection than adults because they spend more time at home and would be engaged in risky behaviors such as playing on and with soil. Thus, domestic sanitation and hygiene are priorities for the action of reducing the prevalence of intestinal parasitic infections [41]. Safe disposal of fecal material and proper life skills, such as hand washing are also an effective barrier for the transmission of intestinal parasitic infections [11].

The possible explanation for the highest prevalence of helminth infections observed in lower aged children would be the chance of harboring more than one helminth infections concomitantly by an individual may become higher as individuals stay longer in endemic areas.

Multiple intestinal parasitic infections, (above one types of parasites per individual) were identified in 27 (7%) of the study subjects. The prevalence of multiple parasitic infections was 8.3%, 5.4% and 11.5% for the age group of 5-10, 11-15 and ≥16 year respectively. There was a higher prevalence of multiple infections in pupil ≥16 years as compared with the younger age groups but no statistically significance difference in the prevalence of multiple intestinal parasitic infections in the age group of the study subjects.

Finally, from 46.1% of positive cases of the surveyed, the prevalence of intestinal protozoan, helminth parasites and multiple infections were found 22.4%, 16.7% and 7%, respectively. Thus, it was interesting to find that in more developed areas; the intestinal protozoan infection seemed to be more of a problem than helminth parasites.

3.2. Intensity of Intestinal Soli-transmitted Helminth Infections

Intensity of helminth parasites was measured as egg per gram (Epg) of faeces in the studied school-children. Result of the intensity (worm burden) of helminth parasites are presented in Table 5 and 6. The overall average egg burdens of helminth parasites were 1341, 311 and 1150 for *A. lumbricoides,* Hookworm and *H. nana,* respectively. The mean egg count and ranges in parenthesis of Hookworm, *A. lumbricoides* and *H. nana* were 500(200 to 800), 2174 (48 to 4300) and 1630 (24 to 3240) egg per gram of faeces, respectively.

Parasites	Parameter	5-10 years	11-15 years	≥16 years
A. lumbricoides	Mean± SEM	1425±0.02	1257±0.02	1200±0.03
Hook worm	Mean± SEM	0	300±0.09	200±0.02
H. nana	Mean± SEM	886±0.01	1171±0.02	0
Total egg count	Mean± SEM	1286	1150	700

Table 3: The Mean ± SEM and Range of Egg Counts of Helminth Parasites per Gram of Faeces(epg) of Studied School-Children by Age group in Alemketema Town, 2010.
epg: - egg per gram of feaces

The mean egg count recorded in the age group of 11-15 years, 1316 was the highest as compared with the other age groups followed by the value recorded for the age group of 5-10 years, 1286 (Table 3). There was a low mean epg value for the age group ≥16 years as compared to other age group. There were no higher differences in the mean egg count of helminth parasites with sex. The intensity of Hookworm and *T. trichuria* with 1-1000 epg is considered as light and with >1000 is considered as moderate and heavy infection but *A. lumbricoides* infection with 1-4999 epg is mild and greater than 5000 epg is considered as moderate and heavy infection [4].

Parasites	Parameter	Male	Female	Overall egg loud
A. lumbricoides	Mean± SEM	1450±0.02	1226±0.14	1341
Hook worm	Mean± SEM	0	433±0.05	311
H. nana	Mean± SEM	917±0.2	1509±0.13	1150
Total egg count	Mean± SEM	1235	1339	1282

Table 4: The Mean ± SEM and Range of Egg Counts of Helminth parasites per Gram of (epg) Faeces of Studied School-Children by Sex in Alemketema Town, 2010.
epg: - Egg Per Gram of Faeces

After accounting for the effects of age and sex of the participant pupils, there was a significant relationship between age group and helminth intensity. The intensity of *H. nana* was lower in the age group of above 16 years than in other age groups. As the age of the students increase the prevalence decreases because *H. nana* infections occur below 15 years. The highest intensity of helminth infections was observed in children aged 11-15 years, except for *A. lumbricoides*, for which the age group of below 10 years had highest intensity of infection. In agreement with the previous study [19] who observed the prevalence of intestinal helminths and to show that children usually become infected with hookworm, *A. lumbricoides* and *T. trichiura* from 6-12 months to 3 years of age. Similarly, the study showed that Hookworm, and *A. lumbricoides* infections increase with age, reaching highest prevalence in late adolescence and 4 to 10 years of age, respectively. In association with this, the mean egg count of *A. lumbricoides* was higher in the age group of 5-10 years and the egg load decrease as the age of the student increase. The intensity of *H. nana* also increases as the age of the pupils increase up to 15 years old.

The mean egg count of *Ascaris lumbricoides,* Hookworm and *H. nana* in studied female pupils were 1226, 433 and 1509, respectively. Similarly, the average total egg burden in female pupils was 1339. The same to this, the mean eggs of *Ascaris lumbricoides* and *H. nana* in male pupils were 1450 and 917 and the average total egg burden was 1235; No Hookworm cases in male pupils (Table 4).

3.3. Anthropometric Measurements of the School-Children

Anthropometric measurements; body mass index, height -for- age, weight-for-height, and weight-for-age for the studied pupils were analysed. BMI, regardless of the standard of WHO, lower than 18.5 kg/m^2 is an indicative of poor nutritional status or underweight, normal at 18.5 to 25 kg/m^2, overweight at 25 to 29.9 kg/m^2, and obesity over 30 kg/m^2. In general BMI greater than 30 kg/m^2 were assumed to be due to excessive obesity (USDA & USDHHS, 2000). Based on this reference, the proportion of the nutritional status of the school-children in the present study below 18 kg/m^2 was 46% and 42.4% of male and female school children, respectively. The proportion of wasted, stunted and underweighted pupils was 32.6%, 10.2% and 42.7%, respectively (table 5).

Anthropometric Indices	Sex		
	Male (n=192)	Female (n=192)	Total
	No. (%)	No. (%)	No. (%)
Weight-for-Age (Underweighted)	81(42.2)	82(42.7)	163(42.7)
Height -for -Age (Stunted)	21(10.9)	17(8.9)	39(10.2)
Weight-for-Height (Wasted)	55(28.6)	69(35.9)	125(32.6)
BMI(<18 kg/m^2)	88(46)	81 (42.4)	169(44)
BMI(18-25 kg/m^2)	104(54)	111(57.8)	215(56)

Table 5: Proportion of Anthropometric Indices by Sex in Alemketema School-Children, 2010.

3.4. Relationships between Intestinal Parasitic Infections with Anthropometric measurements of the Primary School Children

This study has also analyzed correlation between anthropometric indices of the school-children and the prevalence of and intensity of intestinal parasitic infections. In agreement with a previous study done in Ethiopia (Asfaw and Goitom, 2000), anthropometric scores were found to be independent of the overall prevalence of intestinal parasitic infections. However, a study done elsewhere has shown a higher prevalence of helminth infections among the stunted children as compared to those normally nourished children [29].

The overall prevalence for each intestinal parasitic infection was not different among children with or without stunting, wasting and underweight in the present study. But, in comparison of the three anthropometric indices underweighted (19.3%) school-children had a higher prevalence of parasitic infection.

It is possible that although current infection was found to be a risk factor for a chronic condition, current infection parallels infection throughout the earlier lifespan and can therefore be used as a proxy measurement for past infection. It has been demonstrated that individuals are predisposed to certain intensities of infection such that even after treatment, intensity of infection returns to pre-treatment levels [10].

Similarly, the study showed that the anthropometric indices per egg-count class were tabulated between sexes, but they don't show consistent relationships between them and average egg-counts were evident. The mean egg count of the school-children was the same in the wasted, stunted and underweighted and normal pupils.

This finding is consistent with previous studies, which have found *Trichuris, Ascaris* or co-infection with both to be associated with stunting and malnutrition [40]. Several studies among rural populations have failed to find a nutritional impact of gastrointestinal parasitism [27].

In conclusion, the major intestinal parasite species diagnosed in the school children of Alemketema town school-children were *E. histolytica*, *G. lamblia, A. lumbricoides,* Hookworm, *S. stercoralis* and *H. nana.* The finding reported in the present study was that intestinal parasitic protozoan infections represent a public health problem in the school-children of Alemketema town. In addition to the parasitological investigations done by the investigator, the secondary clinical data collected from the Hospital found in the study area also showed that protozoan parasites were a major health problem and more prevalent in the study area. *E. histolytica* infection was severe for the school children.

Therefore, to reduce the prevalence and intensity of intestinal parasitic infections to a low level and to increase the knowledge and awareness about the causes of intestinal parasitic infections, there must be:

- Establishment and maintenances of a network for the treatment of intestinal parasitic infections and provision of health education program in primary schools.
- Provision of mass-treatment with appropriate anti parasitic drugs
- Monitoring the interventions and evaluate the effectiveness of the treatment on infections and morbidity indicators.
- Further studies are required in the study area such as, a longitudinal study on the prevalence of intestinal parasitic infections and other blood protozoan parasites like malaria.

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