Sjournals
Scientific Journals
Scientific Journal of Zoology (2013) 2(12) 117- 132
ISSN 2322-293X
doi: 10.14196/sjz.v2i11.1215

Contents lists available at Sjournals
SCIENTIFIC JOURNAL OF ZOOLOGY
Journal homepage: www.Sjournals.com

Original article

Prevalence of intestinal parasitic infections and their associations with anthropometric measurements of school children in selected primary schools, Wukro town, eastern Tigray, Ethiopia

E. Kidane*, S. Menkir, A. Kebede, M. Desta
Department of Biology, College of Natural and Computational Science, Haramaya University, Haramaya.

*Corresponding author; Department of Biology, College of Natural and Computational Science, Haramaya University, Haramaya.

A R T I C L E I N F O

Article history,
Received 03 December 2013
Accepted 18 December 2013
Available online 29 December 2013

Keywords,
Anthropometry
Intestinal parasites
Prevalence
School children
Wukro

A B S T R A C T

The objective of the present study was to determine prevalence of intestinal parasitic infections and their associations with anthropometric measurements among school children of Wukro town, Eastern Tigray, Ethiopia. The design of the study was a cross-sectional epidemiological investigation involving a sample population of 384 school children from grade one to grade eight in two purposively selected primary schools located in Wukro town during March-May, 2011/2012. A total of 384 fresh stool samples of school-children were examined using direct wet-mount technique. The overall prevalence of intestinal parasitic infection was 60.7% (58.2% in males and 62.8% in females). Multiple infections with two and above parasites were found in 7.5% (29) of the positive stool samples. The prevalence of protozoan parasites, E.histolytica, G.lamblia and I.beli was 23.2%, 16.9% and 4.4%, respectively. Similarly, the prevalence of helminth infections, A.lumbricoides, Hookworm, T. trichiura, S.mansoni, E.vermicularis, H.nana and Teania saginata. was 5.7%, 3.9%, 3.1%, 3.1%, 1.3%, 1% and 0.8%, respectively. The prevalence of intestinal parasitic infections was significantly associated with some of risk factors, such as family size, source of water and its handling, and availability of latrines (p=0.000, p=0.003 and p=0.001, respectively). Even though there were high parasitic infections, they were not statistically associated with some socio-demographic factors, such as parents' educational level, personal hygiene, life skills, awareness to parasitic infections, residence and wearing shoe or not. A significant association was found between intestinal parasitic infections and underweight students (p=0.002). Underweight school-children (34.6%) had a higher prevalence of parasitic infection as compared with other anthropometric indices (wasting and stunting). In summary, intestinal parasitic protozoan infections represent a public health problem in the school-children of Wukro town. Local health sector and any concerned bodies should collaborate with school health program for delivering health education to increase the knowledge, attitude and practice of school children as to how transmission of intestinal parasitic infection is prevented such as improvement of personal hygiene and environmental sanitation, and shoe wearing habit.

1. Introduction

Intestinal parasites are found in the gastrointestinal tract of human and other animals that include protozoan and helminthes. The common intestinal protozoan parasites of human are Entamoeba histolytica/dispar, Giardia lamblia/intestinalis, Cryptosporidium and Cyclospora species. Parasitic helminthes (worms) that infect humans belong to two phyla, Platyhelminths and Nematoda. Parasitic infections, particularly intestinal helminthes cause hundreds of thousands of avoidable deaths each year and are among the world's common infectious diseases. Intestinal helminthes are more prevalent throughout the tropics, especially among poor communities. The most prevalent and important helminthes in developing countries are the soil-transmitted helminthes such as, Ascaris lumbricoides, Trichuris trichiura, hookworms, Hymenolepis nana and Schistosomia mansoni. Schistosmiasis is endemic in 74 tropical countries; worldwide affecting over 200 million people while 500 to 600 million people are at risk of becoming infected (Rosendale, 1997). According to Teklehaimanot et al. (1998), younger children are more susceptible to A. lumbricoides infection than older children. It could be transmitted through the contamination of the environment, especially the soil where the children usually play in the open fields and eat food without washing hands. Thus, as age increases exposure to intestinal nematode infection decreases possibly due to improved personal hygiene. The most common intestinal parasite among adults and child groups surveyed were E. histolytica/dispar, G. intestinalis, A. lumbricoides and T. trichiura (Eckmann and Gillin, 2001). Protozoan parasites, such as Giardia lamblia, Entoameba histolytica and helminthic parasites, including A. lumbricoides, hookworms and whip worm (Trichuris trichiura), are transmitted via contaminated water and food (Chan et al., 1994). Although several studies have been conducted on the distribution and prevalence of intestinal parasites in Ethiopia (Kloos and Tesfayohans, 1993), there are still several localities in the country including the study area, Wukro town, Eastern Tigray, for which epidemiological information of intestinal parasitic infections was not available. This study was initiated with the aim of determining the prevalence of intestinal parasitic infections in relation to anthropometric measurements among school children of selected primary schools in Wukro town, Eastern Tigray.

2. Materials and methods

2.1. Description of the study area

The study was conducted in Wukro wereda of Tigray Regional State Northern Ethiopia (Figure 1). It is located at about 840 km north of Addis Ababa and 45 km north of Mekelle, the capital city of the Regional State. The total population of this town is 33,317. Of which 15,488 (46.5%) are males and 17,829 (53%) are females (CSA, 2007). The annual rainfall of the study area is 400 mm and the average temperature is 17°C - 25°C, with an altitude of about 2100 meters above sea level (WAO, 2007). There are two secondary high schools and two primary schools in

Wukro town. The study has been carried out in the two primary schools, namely Selam Primary School and Kisanet Primary School.There is one higher hospital and one clinic in the town. The inhabitants of Wukro district use agriculture and trade to lead their livelihood. Agriculture is the source of income in the area, where the farming system is characterized by small-scale production of mixed crops and livestock, and trade is the main source of income (Wukro District Agricultural Station, 2009).

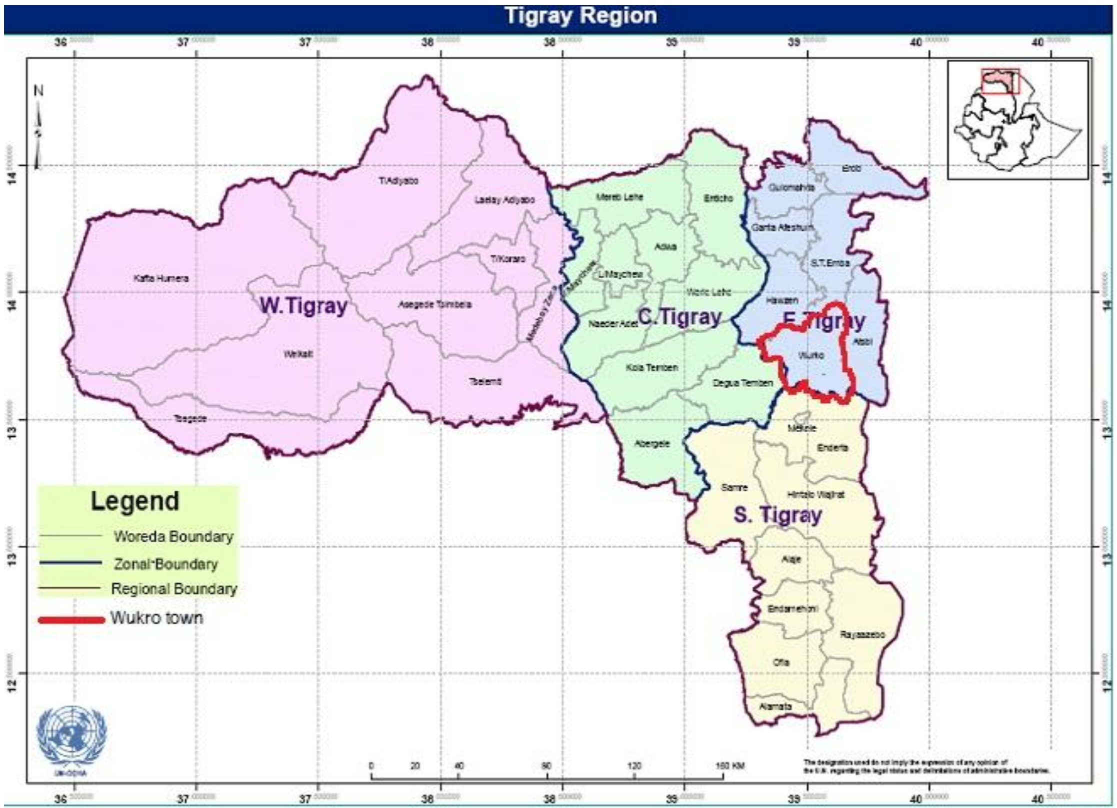

Fig. 1. Location map of the study area.

2.2. Study design

A cross sectional survey was carried out for the assessment of the prevalence of intestinal parasitic infections and their associations with anthropometric measurements of school children in selected primary schools at Wukro town. The survey was conducted from March to May, 2012 at Selam and Kisanet Elementary Schools.

2.2. Sampling size and sampling procedure

The sample size was determined based on the expected prevalence rate of 50% and absolute desired precision of 5% at confidence level of 95%. As a result, a total of 384 school children from grade 1 to 8 were chosen to participate in the present study (Kish and Leslie, 1965). The random sampling technique was employed to select students from each grade and classroom by using class rosters as the sample frame. Students that have been treated for any intestinal parasitic infections for the past three months at the time of survey and those that have been infected with malaria were excluded.

2.3. Methods of data collection

2.3.1. Questionnaire survey

Information about age, sex, family size, source of water and its handling, presence or absence of latrines in their homes, parents' education level, life skills, personal hygiene, level of awareness to parasitic infection and wearing shoes or not were gathered using structured questionnaire after pre-test in the study area.

2.3.2. Anthropometric measurements

The anthropometric measurements were include weight and height by using the standardized procedures mentioned in Gibson, (2005) and body mass index (BMI) was calculated using the formula, BMI=weight in kg/ [height in m] 2.Weight was taken without shoes and minimum clothing using weighing scale and was recorded to the nearest 0.1 Kg. The height was measured to the nearest 0.1 cm using a measuring tape. The age of each child was recorded during sample collection. All the data were transformed and expressed in Z-scores and calculated using anthropometry calculating software program AnthroPlus (WHO, 2007). Under-nutrition was defined for a child, who had less than-2 z-scores (-2SD) from the National Center for Health Statistics (NCHS) median reference population values (WHO, 2007).

2.3.3. Stool sample and examination techniques

During stool 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 5g 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 Wukro hospital on the same day of collection for parasitological examination and enumeration.

2.4. Laboratory parasitological examination of stool samples

Stool samples were diagnosed for the presence of intestinal parasites using direct wet-mount method. The processed stool samples were checked for the presence of intestinal parasite ova or cysts under light microscopy using objectives 10x and 40x. 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 (Cheesbrough, 1990).

2.4.1. Direct wet mount technique

Wet mounting is the simplest and easiest technique for the examination of faeces. Direct wet mount technique was used to assess the overall prevalence of intestinal parasitic infections in the study area. The direct wet mount was processed by conventional iodine to identify the presence of motile intestinal parasites, cycts, egg and trophozoite under light microscope at 10X and 40x magnification. Saline was used to observe cysts of intestinal parasites (Singh et al., 2004). About 2g of stool samples was emulsified with 3-4 ml normal saline, and then a drop of emulsified sample placed on a clean microscopic glass slide, then a few drops of iodine solution was added and it was covered with a cover slip. The presence of intestinal parasites ova and cyst was observed under the microscope (Lindo et al., 1998).

2.5. Data analysis

Statistical Package for Social Science (SPSS), Windows version 16 was used for data analysis. Descriptive statistics were applied to indicate the prevalence of intestinal parasitic infections and nutritional status as percentages and proportions. To test the null hypothesis, inferential statistical analysis of comparisons between two categorical variables were carried out using Pearson chi-square (x2) test verifying the relationship between independent factors and the outcome variables. The significance of the differences in frequency distribution was tested by using chi-square analyses. Anthropometry indices were computed using the calculator mode of anthropometry calculating software program AnthroPlus (WHO, 2007). Wasting, stunting and underweight were defined as Z-score values of less than –2 SD (Standard Deviation), which was below what is expected on the basis of the international growth reference scale (WHO, 2007). P-values ≤ 0.05 were considered statistically significant.

3. Results and discussion

3.1. Socio-demographic characteristics of study participants

Socio-demographic characteristics of the study participants are summarized and presented in Table 1. A sample population of 384 (177 males and 207 females) were selected randomly for parasitological investigations (Table 1). A total of 182 and 202 students were randomly selected from Selam and Kisanet Primary Schools, respectively. The sample study subjects were divided into three age groups, 6- 9 years, 10-14 years, and 15- 18 years. The mean age of the study population was 11 years, and the ages range from 6 to 16 years. 133 (34.6%) of the students were 6-9 years old, 215(55.9%) were 10-14 years old and 36(9.4%) were 15-18 years old. More than 50% of the sample study populations were in the age group of 10-14 years old (Table 1). As shown in Table 1, 40.4% and 59.6% of the respondents said that they have family size of <5 and >6, respectively (Table1). About 51.8% of them also indicated that they have protected water supply for domestic uses. However, 47.2% were using unprotected water. With regard to parents' education, 104 (36.5%), 106 (27.6%), 96 (25%) and 42 (10.9%) said that they were illiterate, can read and write, completed primary education and had diploma and above respectively. 149 (38.8%) of the students' households had latrines in close vicinity of their homes. The remaining 235(61.2%) did not have latrines at their homes. 205 (53.4%) and 179 (46.6%) were with poor and good personal hygiene, respectively. About 199 (51.8%) participants' were with poor life skills and the remaining 185 (48.2%) were with good life skills. 209 (54.4%) and 175 (45.6%) were with poor and good awareness to parasitic infection respectively. From a total of 384 study participants, 370 (94.4%) were from urban and 14(3.6%) were from rural settings. 378 (98.4%) of the children were wearing shoes regularly, 6 (1.6%) were not wearing shoes (Table 1).

Table 1
Socio- demographic characteristics of study participants in both Selam and Kisanet primary schools.

Characters	Frequency	Percent (%)
Sex, Male	177	46.1
Female	207	53.9
Age group, 6-9	133	34.6
10-14	215	56
15-18	36	9.4
Family size, <5	155	40.4
>6	229	59.6
Source of water & its handling,		
Protected	199	51.8
Unprotected	185	47.2
Parents education level,		
Illiterate	104	36.5
Can read and write	106	27.6
Primary education complete	96	25
Diploma and above	42	10.9
Availability of latrine, Present	149	38.8
Absent	235	61.2
Personal hygiene, Poor	205	53.4
Good	179	46.6
Life skills, Poor	199	51.8
Good	185	48.2
Awareness to parasitic infection,		
Poor	209	54.4
Good	175	45.6
Residence , Urban	370	94.4
Rural	14	3.6
Wearing shoes , yes	378	98.4
No	6	1.6

3.2. Prevalence of intestinal parasitic infections in school children

The results of the prevalence of intestinal parasitic infections among the primary school-children of Wukro town by age and sex of the study subjects were summarized and presented in Table 2. The overall prevalence of intestinal parasitic infections among all age groups of the pupils in both schools was 60.7%. Of these, the prevalence of any intestinal parasitic infections for males and females was 58.2% and 60.8%, respectively. The prevalence of any intestinal parasitic infection for the age group 6-9 was 57.4% and 72.2% in males and females, respectively. While, for the age group 10-14 it was 57.7% for males and 58.8% for females. The prevalence of intestinal parasitic infection for the age group of 15-18 year was 66.7% and 66.7% for males and females, respectively (Table2). The higher prevalence of intestinal parasitic infection was seen in the age groups of 6-9 and 15-18 years which indicated that younger children are more exposed since they usually play in the open fields and eat food without washing hands. Thus, as age increases the prevalence of parasitic infection decreases possibly due to improved personal hygiene and reduced contact with soil. These findings are in agreement with that reported by Tadesse and Beyene (2003) from Tigray. The prevalence of protozoan parasites between male and female pupils was 36.7% and 47.3%, respectively (Table 2). Similarly, the prevalence of helminthic parasites between male and female pupils was 38 (21.5) and 32 (15.5), respectively (Table 2). The prevalence of the three intestinal protozoan parasites among the three age groups of the participants of the study was 47.7%, 39.5% and 41.7% for 6-9, 10-14 and 15-18 years, respectively (Table2). An overall prevalence of helminthes infections in the studied pupils was 18.2%. The prevalence of the seven helminth parasites among the age groups of 6-9, 10-14 and 15-18 years was 18%, 17.2% and 25%, respectively. The possible explanation for the highest prevalence of helminthes infections observed in lower aged children would be the chance of harboring more than one helminthes infections concomitantly by an individual may become higher as individuals stay longer in endemic areas. Generally, the prevalence of parasitic infections was higher in the age group of 6-9 years (64.8%) and in the age group of 15-18 years (66.7%) 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 (Oguntibeju, 2006). Children usually do not take care of their personal hygiene. For instance, they play in contaminated outdoor environments, in and around disposal sites (which can certainly cause serious health problems), face problems of absence of latrine and lack of basic life skills, such as washing hands before and after meals (Abu Mourad, 2004)

The reason for the higher prevalence infection of protozoan parasites than helminthes infection for this study could be due to modes of transmission of the parasites. Protozoan parasites are transmitted through contaminated hands, food etc whereas helminthes parasites were by fecal-oral means. The difference in parasitic infections between sexes that is higher in females than males could be due to modes of transmission of the parasites, sample size determination, study population and the methods used could attribute to this observed difference in detections of various parasites. Finally, from 60.7% of positive cases of the surveyed school children, the prevalence of intestinal protozoan and helminth parasitic infections were found to be 42.4% and 18.2%, respectively (Table 2). Thus, it was interesting to find that the intestinal protozoan infection seemed to be more of a problem than the helminth parasites. There are difference among the variations in geography, socio-economic conditions, and cultural practices of the population under consideration. Such declines in prevalence of intestinal parasitic infections are heartening, and thus school-based prevention and control programs should be strengthened (Tadesse, 2002).

3.3. Major intestinal protozoan and helminth parasites identified in examined children

Protozoan and helminth parasites identified in the stool samples of the examined school-children are presented in Table 3. The result of parasitological investigations showed that, from 384 specimens of the school-children, 233 (60.7%) were positive for one or more intestinal parasites. Of these, 58.2% and 62.8% were males and females, respectively. Entamoeba histolytica, Giardia lamblia and Isospora beli were the major protozoan parasites identified from the school- children with the prevalence of 23.2%, 16.9% and 4.4%, respectively (Table 3). Amoebic dysentery due to E.histolytica infection was the second most common cause of death in the world after malaria among intestinal protozoan parasites (Walsh et al., 1998). The high occurrence of the parasitic protozoan infections in the present study may be due to poor environmental sanitation (including poor disposal of swages), which favor the persistence of cyst of the parasites in the soil. According to Yeneneh (1994), the prevalence of intestinal parasite infections was 82.7% in residents of 4 villages in Southwestern Ethiopia. Similar studies done by Mengistu and Berhanu (2004), on the school children in Lake Langano showed that the prevalence of intestinal parasitic infection was 60.2%. Another study conducted by Legesse and Erko, (2004) among school-children around Lake Langano also showed that the prevalence of intestinal parasitic protozoan parasites was 83.8%. This result was higher than another school-based study done in Jimma by Haile et al, (1994) who reported a prevalence of 68.4%. Similarly, the prevalence of amoebiasis and giardiasis in Southwest Ethiopia was also 3.1% and 3.6%, respectively (Amare et al., 2007). The three potential protozoan species in the present study were 42.4 %, among 384 school-children of Wukro town. Thus, a higher prevalence of E.histolytica (23.2%) was found among school-children as compared with G.lamblia (16.9%) and I.beli (4.4%) (Table3). Similarly, the major helminth parasites identified in the stool samples of the school- children were A.lumbricoides, Hookworm, T. trichiura, S.mansoni, E.vermicularis H.nana and Teania spp. with the prevalence of 5.7%, 3.9%, 3.1%, 3.1%, 1.3%, 1% and 0.8% respectively. These seven helminth parasites were found with an overall prevalence of 18.2% (Table 3). Besides, the prevalence of Teania spp. infection was lower next to H.nana and

E.vermicularis among the school-children of Wukro town with the prevalence of 0.8%, 1% and 1.3%, respectively. A.lumbricoides, Hookworm and T. trichiura are the most prevalent helminth parasites worldwide (Warren et al., 1993). In the present study, A.lumbricoides, T.trichura, Hookworm and s.mansoni, 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%. 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.

Table 2

Prevalence of intestinal protozoan and helminth parasites by age and sex of examined children in both Selam and Kisanet primary schools.

Age group (in year) and sex	No. of Examined (%)	Protozoan parasite	Helminths Parasite	Protozoa & helminths parasite	X2	P-value
		No. positive (%)	No. positive (%)	No. positive (%)		
6-9						
Male	61(45.9)	24(39.3)	11(18)	35(57.4)	2.06	0.14
Female	72(54.1)	39(54.2)	13(18.1)	52(72.2)		
10-14						
Male	104(48.4)	37(35.6)	23(21.1)	60(57.7)	0.28	0.59
Female	111(51.6)	48(43.2)	14(12.6)	62(55.7)		
15-18						
Male	12(33.3)	4(33.3)	4(33.3)	8(66.7)	0.06	0.79
Female	24(66.7)	11(41.7)	5(20.8)	16(66.7)		
All age group						
Male	177(46.1)	65(36.7)	38(21.5)	103(58.2)	0.14	0.83
Female	207(53.9)	98(47.3)	32(15.1)	130(62.8)		
Total	384(100)	163(42.2)	70(18.2)	233(60.7)		

Table 3
Major intestinal protozoan and helminth parasites identified in examined children in both Selam and Kisanet primary schools

Age group (in year) and sex	No. of examined (%)	Protozoan parasitic species			Helminth parasitic species.							Multiple parasitic infection
		Eh	Gl	Ib	Al	Hw	Tt	Sm	Hn	Ts	Ev	
		No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)	No. of positive (%)
6 to 9												
	61(45.8)	14(22.9)	10(16.3)1	1(1.6)	4(6.5)	3(4.9)	1(1.6)	1(1.6)	1(1.6)	1(1.6)	- 1(1.3)	
Male	72(54.1)	25(34.7)	4(19.4)	4(5.5)	4(5.5)	1(1.3)	4(5.5)	2(2.7)	1(1.3)	1(1.3)		3(49.2)
Female												11(15.3)
10 to 14												
	104(48.3)1	21(20.1) 23	16(15.3)2	2(1.9)	6(5.7)	6(5.7)	3(3)	4(3.8)	2(1.9) -	-	4(3.8) -	
Male	11(28.9)	(20.7)	0(18)	7(6.3)	4(3.6)	4(3.6)	3(2.7)	3(2.7)		-		9(8.7)
Female												3(2.7)
15 to 18												
Male	12(33.3)	1(8.3)	2(16.6)	1(8.3)	1(8.3)	1(8.3)	1(8.3)	-	-	1(8.3)	-	2(16.7)
Female	24(66.7)	5(20.8)	3(12.5)	2(8.3)	3(12.5)	-	-	2(8.3)	-	-	-	1(4.2)
All age group												
Male	177(46.1)	36(20.3)	28(15.8)	4(2.3)	11(6.2)	10(5.6)	5(2.8)	5(2.8)	3(1.7)	2(1.1)	4(2.3)	14(79.1)
Female	207(53.9)	53(26.5)	37(17.9)	13(6.3)	11(5.3)	5(2.4)	7(3.4)	7(3.4)	1(0.5)	1(0.5)	1(0.5)	15(72.5)
Total	384(100)	89(23.2)	65(16.9)	17(4.4)	22(5.7)	15(3.9)	12(3.1)	12(3.1)	4(1)	3(0.8)	5(1.3)	29(7.5)

Eh=Entamoebahistolytica, Gl= Giardia lamblia, Ib=Isospora beli Al=Ascaris lumbricoides, Hw=Hookworm, Tt=Trichuris trichiura, Hn= Hymenolepsis nana, Ev= Enterobius vermacularis, Sm=schistosoma mansoni, Ts=Teania saginata

Regarding the number of intestinal parasite infections per individual, more than one parasite was found in participants of the study subjects. Multiple infections were seen in 29 (7.5%) pupils of the total examined school-children (384) with intestinal (two protozoan/protozoa and helminth/two helminth) parasites with the prevalence of 2.3%, 4.4% and 0.8%, respectively. In the present study, the prevalence of multiple parasite infections between male and female pupils was almost the same. The prevalence of multiple parasite infections between male and female pupils was 3.6% % and 3.9%, respectively. The prevalence of multiple parasitic infections was 9%, 4.7% and 8.3% for the age groups of 6-9, 10-14 and 15-18 year, respectively (Table 3). 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 (Solomon, 2006). Multiple infections were observed in 10.2% of the positive cases. According to the report of Solomon (2006), the prevalence of Hookworm infections was significantly higher (P< 0.001) in the age group of 14 years and above than younger age groups. Similarly, in this study the prevalence of A. lumbricoides and T.trichuria infections was significantly higher (P < 0.001) in age group of 6 - 14 years than other age groups. On the other hand, the prevalence of Hookworm, A. lumbricoides and T. trichiura infections was not significantly different in both sexes (P< 0.001). Higher prevalence of parasitic infections in the age group of ≥16 years may occur due to the poor sanitary conditions in the schools (Oguntibeju, 2006). 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 (Abu Mourad, 2004). The study done in 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 reported by Roma and Worku, (1997). The prevalence of multiple infection observed by Lo et al., (1989) in Eastern Ethiopia was 45.9% and higher than the study done by Roma and Worku, (1997). In relation with this, the school-children of Wukro town showed lower prevalence of multiple infections than the works done earlier in other parts of the country.

3.4. Association of intestinal parasitic infections with socio demographic characteristics of school children

This study has also analyzed correlation between socio-demographic factors of the school-children and the prevalence of intestinal parasitic infections. The overall prevalence of each intestinal parasite species diagnosed in the study of pupils and the proportion of different socio-demographic factors are presented in (Table 4). Among the 233 positive participants of the study, 61 (39.6%) and 172 (71.5%) were with <5 and >6 family size, respectively. Out of 199(51.8%) participants of the study that used protected water, 70(35.2%) were found to be positive for protozoan parasites and 22(11.9%) for helminthic infection. From the 185(47.2%) participants of the study that use unprotected water, 93(50.3%) were found to be positive for protozoan and 48(24.1%) for helminthic infection. In this study, family size and source of water and its handling were the major risk factors for the prevalence of intestinal parasites (p=0.000 and p=0.003, respectively) (Table 4). Among 62(44.3%) protozoan and 27(19.3%) helminthes parasitic infections, 140(36.5%) participants of the study were with illiterate parents. About 46(43.4%) protozoan and 16(15.1%) helminthes parasitic infections, 106(27.6%) participants of the study were with parents who can read and write. From 96(25%) participants of the study whose parents completed Primary education, 42(43.8%) were found to be positive for protozoan and 21(21.9%) for helminthes infection. The remaining 42(10.9%) participants' of the study parents who had diploma and above, 13(31%) were found to be positive for protozoan and 6(14.3%) for helminthes infection. 149 (38.8%) of the students' households had latrines in close vicinity in their homes, 40(26.8%) were found to be positive for protozoan parasite and 15(10.1%) for helminthes infection. The remaining 235(61.2%) of the students' households did not have latrines in their homes were found to be positive for protozoa and helminthes, that is 123(52.3%) and 55(23.4%), respectively. There was statistically significant association between prevalence of parasitic infection and latrine availabilities (p=0.001) (Table4). There was statistically significant association between family size and rate of helminthes infection (P=0.0003). The prevalence rate of intestinal helminths in terms of family size was found to be 29%, 51.3% and 19.6% for family size of 1-3, 4-6 and >6, respectively. The highest prevalence rate was recorded among those using pit latrines (57.6%), that is, p=0.004. The majority of the school children (43.4%) use stream water. Seventy two percent (72%) of the pupils drink water without any form of treatment and the prevalence of helminthiasis among them was 84.2%. There was a statistically significant association between water treatment method and prevalence of helminthiasis (P<0.0001) (sierra, 2011). In the present study, out of 205(53.4%) participants of the study who were with poor personal hygiene, 90(43.9%) and 37(18%) were found to be positive for protozoan and helminthes parasites infections, respectively (Table4). About 179(46.6%) participants of the study who were with good personal hygiene, 73(40.8%) and 33(18.4%) were found to be positive protozoan and helminthes parasites infections, respectively (Table4). In this study, only 43.9% were identified as having good awareness to hygiene. Parasitic infections depend for transmission on environments contaminated with egg-carrying feces. Consequently, intestinal parasites are intimately associated with poverty, poor sanitation, and lack of clean water. The provision of safe water and improved sanitation are essential for the control of parasitic infections. The peoples in developing countries live in conditions that are highly conducive to the acquisition of parasitic infestation. Poor hygiene, crowded household conditions, dietary habits, education level of the community and deficient sanitation mark their day-to-day life (Culha et al., 2007).

Among the 199(51.8%) participants who were with poor life skills, 86(43.2%) and 35(17.6%) were found to be positive for protozoan and helminthes parasitic infections, respectively. From remaining 185 (48.2%) individuals who were with good life skills, 77(41.6%) and 35(17.9%) were found to be positive for protozoan and helminthes parasites infections, respectively. Among the 209 (54.4%) and 175 (45.6%) participants of the study who were with poor and good awareness to parasitic infection, 98(49.2%) and 65(35.1%) participants of the study were found to be positive for protozoan parasitic infections, respectively. The remaining 37(18.6%) and 33(17.8%) participants of the study were found to be positive helminths parasitic infections to the study subjects who were with poor and good awareness to parasitic infections, respectively. From 370 (94.4%) urban participants of the study, 153(41.4%) and 69(18.6%) were found to be positive protozoan and helminthes parasitic infections, respectively. From remaining 14(3.6%) rural participants of the study, 10(71.4%) and 1(7.1%) were found to be positive for protozoan and helminthes parasitic infections, respectively. 378 (98.4%) of the children who wore shoes regularly were found positive for protozoa and helminthes, that is 160(42.3%) and 67(17.7%), respectively. From 6 (1.6%) participants of the study who did not wear shoes were found to be positive for protozoa and helminthes, 3(50%) and 3(50%), respectively (Table4). In this study, intestinal parasitic infections are highly prevalent. This is due to children 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, sanitation and hygiene are priorities for the action of reducing the prevalence of intestinal parasitic infections (WHO, 1997). 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 (Curtis et al., 2000). Children are more receptive to learning and are very likely to adopt healthy behaviors at younger age. They can also be agents of change by spreading what they have learned in the school to their family and community members. Enhanced, comprehensive knowledge about these issues should be used to improve low-cost but highly effective programs that will meaningfully attenuate the burden of transmissible diseases among students in rural settings (Lopez-Quintero et al., 2009).

Generally, the prevalence of intestinal parasitic infections and some risk factors such as family size, source of water and its handling and availability of latrine are statistically significant. In the present study, there was high parasitic infection, but there was no statistically significant difference between some socio-demographic factors such as parents education level, personal hygiene, life skill, awareness to parasitic infection, residence and wearing shoe or not .

Table 4
Association of intestinal protozoan and helminth parasitic infections with some socio-demographic characteristics of studied children in both Selam and Kisanet primary schools.

Characters	Frequency (%)	Intestinal protozoan	Intestinal Helminth	Over all parasites	OR	X2	P-value
		No. positive (%)	No. positive (%)	No. positive (%)			
Family size, <5	155(40.4)	46(29.7)	15(9.7)	61(39.6)	13.638	12.752	0.000
>6	229(59.6)	117(51.1)	55(24)	172(75.1)			
Source of water & is handling,							
Protected	199(51.8)	70(35.2)	22(11.9)	92(46.2)	8.970	8.941	0.003
Unprotected	185(47.2)	93(50.3)	48(24.1)	141(76.2)			
Parents education,							
Illiterate	140(36.5)	62(44.3)	27(19.3)	89(63.6)			
Can read and write	106(27.6)	46(43.4)	16(15.1)	62(58.5)	2.514	2.522	0.471
Primary education complete	96(25)	42(43.8)	21(21.9)	63(65.6)			
Diploma and above	42(10.9)	13(31)	6(14.3)	19(45.2)			
Availability of latrine,							
Present	149(38.8)	40(26.8)	15(10.1)	55(36.9)	11.638	10.881	0.001
Absent	235(61.2)	123(52.3)	55(23.4)	178(75.7)			
Personal hygiene, Poor	205(53.4)	90(43.9)	37(18)	127(61.9)	0.732	0.731	0.393
Good	179(46.6)	73(40.8)	33(18.4)	106(59.2)			
Life skills, Poor	199(51.8)	86(43.2)	35(17.6)	121(60.8)	0.079	0.079	0.778
Good	185(48.2)	77(41.6)	35(17.9)	112(60.5)			
Awareness to parasitic infection,							
Poor	209(54.4)	98(49.2)	37(18.6)	136(68.3)	1.551	1.415	0.234
Good	175(45.6)	65(35.1)	33(17.8)	97(52.4)			
Residence , Urban	370(94.4)	153(41.4)	69(18.6)	222(60)	1.84	1.697	0.193
Rural	14(3.6)	10(71.4)	1(7.1)	11(78.6)			
Wearing shoes ,Yes	378 (98.4)	160(42.3)	67(17.7)	227(60)	0.58	0.057	0.812
No	6 (1.6)	3(50)	3(50)	6(1)			

OR = Odds ratio

3.5. Anthropometric measurements of school-children

As recommended by WHO (2007), the anthropometric measurements of children in the present study were compared with an international reference population defined by the U.S. National Centre for Health Statistics (NCHS). Centers for Disease Control and Prevention (CDC). Each of the three nutritional status indicators described below was expressed in standard deviation units (Z-scores) from the median of the reference population (Table 5). Each of these indicators, weight-for-age, weight-for-height, and height-for-age provides different information about growth and body composition, which is used to assess nutritional status. The height-for-age index is an indicator of linear growth retardation and cumulative growth deficits. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered short for their age (stunted) and are chronically malnourished. Children who are below minus three standard deviations (-3 SD) from the median of the reference population are considered severely stunted. Stunting reflects failure to receive adequate nutrition over a long period of time and is also affected by recurrent and chronic illness. Height-for-age, therefore, represents the long-term effects of malnutrition in a population and does not vary according to recent dietary intake (CSO, 2005). As revealed in Table5, 59(44.3%), 38(28.6%) and 36(27%) of the study children aged 6-9 showed underweight, wasting and stunting, respectively. Of these 40.9% were males and 47.2% were females for underweight, 37.7% males and 20.8% females for wasting and 21.3% males and 31.9% females for stunting. Prevalence of underweight and stunting was almost the same between boys and girls in this age group. Even though there was no statistically significant difference in wasting, there was difference between males and females, i.e. 37.7% males and 20.8% females (Table 5). Other study done on school-children of Babile town by Girum Tadesse (2005) showed that Wasting (WHZ) was the predominant manifestation of malnutrition (11.6%) followed by stunting (HAZ) (5.4%) and underweight (WAZ) (5.2%). As compared with this study, there was a higher proportion of underweight and stunting with 44.3% and 27%, respectively. Stunted students show a higher prevalence of parasitic infection than the other anthropometric measurements (Girum, 2005).

Table 5
Prevalence of weight-for-age, height-for-age, and weight-for-height status among males and females of study children aged 6-9 years in both Selam and Kisanet primary schools.

Participants of the study	Total examined (%)	Nutritional Indicators		
		WAZ (underweight) Frequency (%)	WHZ (wasting) Frequency (%)	HAZ (stunting) Frequency (%)
6-9				
Male	61(45.9)	25(40.9)	23(37.7)	13(21.3)
Female	72(54.1)	34(47.2)	15(20.8)	23(31.9)
Total	133(34.6)	59(44.3)	38(28.6)	36(27)
X2		1.521	0.632	0.432
P- value		0.162	0.278	0.845

5.6. Prevalence of underweight and/or thinness in the school children

BMI-for-age is the recommended indicator for assessing thinness, overweight and obesity in children 10-19 years (WHO, 2009). Therefore, in the current study, the prevalence of BMI-for-age under 5th percentiles which were an indicator for being underweight for 10-18 years of age was 49% (123/251). Of which, 52.6% (61/116) was for males and 45.9% (62/135) was for females. Besides, BMI-for-age percentiles of 5th - 85th, and > 85th were calculated for analyzing the status of normal growth and to assess risks for overweight and/or obesity, respectively. However, there was no any risk of overweight among the studied school children (Table 6).

Table 6
Prevalence of underweight and/or thinness in the age group 10-18 years by gender among school children.

Sex	Total examined%	BMI-for-age under 5th percentiles	BMI-for-age 5th – 85th percentiles
Male	116(30.2%)	61 (52.6%)	55 (47.4%)
Female	135 (35.2%)	62(45.9%)	73(54.1%)
Total	251 (65.4%)	123(49%)	128 (51%)

Key, BMI= Body Mass Index

The prevalence of underweight among age group 10-18 years in the present study (49%) was higher than the prevalence of underweight (36%) reported from Southern Ethiopia (Birmeka, 2007). On the other hand, the prevalence reported for Abchikeli and Ayalew Mekonnen Elementary school children was 30.7% by Tilahun (2010).

Generally, in the present study, the prevalence of wasting (28.6%) and underweight (44.3%) among age group 6-9 years were found to be higher than those of both the regional and the national rates, where wasting was 6.5% both nationally and regionally, and underweight was 29.7% regionally, but 20.8% nationally (FMOH, 2005). However, the prevalence of stunting (27%) in the present study was found to be lower in comparison with the Ethiopian Demographic and Health survey report which was 51.3% (CSO, 2005). The higher rates of acute malnutrition in the present study may be due to inadequate dietary intake, cultural, religious, or other factors associated with low socio-economic development such as differences by place of residence and mother's education level as reported by EDHS (2005).

3.7. Association of intestinal parasitic infection and physical growth of school children

This study has also analyzed correlation between anthropometric indices of the school-children and the prevalence of intestinal parasitic infections. The overall prevalence of each intestinal parasite species diagnosed via pupils employed in the study and the proportion of different anthropometric measurements was presented in Table 7. The prevalence of intestinal parasitic infections was higher in underweighted students than wasted and stunted pupils (Table 7). A significant association was found between intestinal parasitic infections and underweighted students (p=0.002) in the age group, 6-9 years. Comparison of the three anthropometric indices showed that underweighted (34.6%) school-children had a higher prevalence of parasitic infection than the other indices. Wasted and stunted school-children showed a prevalence of 18.8% and 21.1%, respectively (Table 7). The prevalence of intestinal parasitic infections had also a relationship with the BMI of the school-children, i.e. 61.8% of the infected pupils. On the previous study done by Asfaw and Goitom (2000) in Ethiopia, anthropometric scores in the present study were found to be independent of the 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 (Quihui-Cota et al., 2004).

4. Conclusion

The objective of the present study was to determine the prevalence of intestinal parasitic infections and their associations with anthropometric measurements among school-children of Wukro town, Eastern Tigray, Ethiopia. The design of the study was a cross-sectional epidemiological investigation involving a sample population of 384 school-children from grade one to grade eight who were selected randomly from two primary schools located at Wukro town during March-May, 2011/2012 Academic years. A total of 384 stool samples were collected and examined using direct wet-mount technique. After screening of 384 stool specimens, the overall prevalence of intestinal parasitic infections was 60.7% (58.2% of males and 62.8% of females) with the prevalence of 42.4%, 18.2% and 7.5% of protozoan, helminth parasites and multiple infections, respectively. The prevalence of protozoan parasites, E. histolytica, G.lamblia and I.beli was 23.2%, 16.9% and 4.4%, respectively.

Table 7

Association of Intestinal Parasitic Infection with anthropometric measurements children in both Selam and Kisanet primary schools.

Nutritional Indicators	**No. of Examined (%)**	**Protozoan parasites Positive (%)**	**Helminth parasites Positive (%)**	**Over all parasites Positive (%)**	**OR**	**X2**	**P- value**
For 6-9 age group	133(34.6)	63(47.4)	24(18)	87(65.4)			
WAZ							
Not under weight	67(50.4)	33(52.4)	8(33.3)	41(30.4)	10.248	9.753	0.002
Under weight	66(49.6)	30(47.6)	16(66.7)	46(34.6)			
WHZ							
Not wasted	86(64.7)	28(40)	41(37.6)	69(51.9)	0.715	0.719	0.396
Wasted	47(35.3)	19(30.2)	6(25)	25(18.8)			
HAZ							
Not Stunted	87(65.4)	26(37.1)	38(34.9)	64(48.1)	0.162	0.161	0.688
Stunted	46(34.6)	20(31.7)	8(33.3)	28(21.1)			
For 10-18 age groups	251(65.4)	100(39.8)	46(18.3)	146(58.2)			
Under weight/ Thinness							
Yes(<5th …)	123(49)	29(23.6)	76(61.8)	6.049		5.816	0.162
No(>5th …)	128(51)	17(13.3)	70(54.7)				

OR, odd ratio

Similarly, the prevalence of helminth parasitic infections for A.lumbricoides, Hookworm, T. trichiura, S.mansoni, E.vermicularis, H.nana and Teania. spp. was 5.7%, 3.9%, 3.1%, 3.1%, 1.3%, 1% and 0.8%, respectively. The prevalence of intestinal parasitic infections was significantly associated with some of risk factors, such as family size, source of water and its handling, and availability of latrines (p=0.000, p=0.003 and p=0.001) respectively. Even though, there were high parasitic infections, they where not statistically associated with some socio-demographic factors, such as parents' educational level, personal hygiene, life skills, awareness to parasitic infections, residence and wearing shoe or not. Anthropometric measurements of the pupils were measured and the relationships with the prevalence of intestinal parasitic infections were analyzed. The prevalence of intestinal parasitic infections was higher in underweighted (34.6 %) students than wasted and stunted pupils. A significant association was found between intestinal parasitic infections and underweight students (p=0.002). Wasted and stunted school-children had a prevalence of 18.8% and 21.1%, respectively. Even though there was no significant difference between the BMI of school children and parasitic infections, but the prevalence of intestinal parasites in the school children were high (61.8%).

The major intestinal parasite species diagnosed in the school children of Wukro town (in both Selam and Kisanet primary schools) were E. histolytica, G.lamblia, I.beli, A.lumbricoides, Hookworm, T. trichiura, S.mansoni, E.vermicularis, H.nana and T. saginata. The findings in the present study showed that intestinal parasitic protozoan infections were the major public health problems in the school-children of Wukro town. E. histolytica, G.lamblia infections were common for the school children. A.lumbricoides, Hookworm, T. trichiura and S.mansoni were found as a dominant species of intestinal helminth parasites diagnosed in the stool samples of the school-children.

References

Abu Mourad, T.A., 2004. Palestinian refugee conditions associated with intestinal parasites and diarrhoea, Nuseirat refugee camp as a case study. J. Publ. Health., 118, 131-142.

Amare, M., Solomon, G.S., Tesfeye, K., 2007. Prevalence of intestinal parasitic infections among urban dwellers in southwest Ethiopia. Ethiop. J. Health Dev., P. 21(1).

Asfaw, T.S., Goitom, L., 2000. Malnutrition and enteric parasitoses among under-five children in Aynalem village, Tigray. Ethiop. J. Health Dev., P. 14,67-75.

Birmeka, M., 2007. Intestinal helminthic infections and their effect on nutritional status in elementary school children and pregnant women, Attat, Gurage Zone,Southern Ethiopia, AAU(unpublished). P1-72.

Chan, M.S., Medley, G.F., Jamison, D., Bundy, D.A., 1994. The evaluation of potential global morbidity attributable to the intestinal nematode infection. Parasitol., 109, 373-87.

CSO., 2005. Central Statistical Office. , *Ethiop. Demograph. Health Survey 2005.*

Culha, G., Kemal, M., Ozer, C., 2007. The Distribution of Intestinal Parasites among Turkish Children Living in rural area. Midd. East J. Fam. Med., Vol.6, Issue 6.Ed., 3(1),20- 25.

Curtis, V., Caircross S., Yonli, R., 2000. Domestic hygiene and diarrhoea pinpointing the problem. Trop. Med. Int. Health., 5,22-32.

FMOH., 2005. Nutritional status and child care. Health and Health related indicators, 2004/5.Federal Ministry of Health. Plann. Program. Depar., P18-19.

Gibson, R.S, 2005. Principle of nutrition assessment. Second editioned. Oxford, Oxford University Press.

Gillespie, S.H., 2001. Intestinal nematodes. In, Gillespie SH, Pearson RD, eds. Principles and Practice of Clinical Parasitology. Chichester, John Wiley and Sons, 561-83.

Girum, T., 2005. The prevalence of intestinal helminthic infections and associated risk factors among school children in Babile town, eastern Ethiopia. Ethiop. J. Health Dev., 19(2),140-147.

Haile, G., Jirra, C., Mola, T., 1994. Intestinal parasitism among Jiren elementary and junior secondary school students, southwest Ethiopia. Ethiop. J. Health Dev., 8,37-41.

Ibrahim, H., Yassin, M., shubair, M.E., Ali Hindi, A.I., Jadallah, S.Y., 1999. Prevalence of intestinal parasites among school children in Gaza city, Gaza strip. J. Egypt. Soc. parasitol., 29, 365-73.

Kish., Leslie., 1965. Survey Sampling, John and Sons, New York.

Kloos, H., Tesfa-Yohannes, T., 1993. Intestinal parasitism. In, Kloss H, Zein AH, editors. Ecol. health disease Ethiop. Westview Press, Colorado. USA. p. 223.

Legesse, M., Erko, B., 2004. Prevalence of intestinal parasites among schoolchildren in a rural area close to southeast of Lake Langano, Ethiop. Ethiop. J. Health Dev.,18,116-120.

Lopez-Quintero, C., Freeman, P., Neumark, Y., 2009. Hand washing among school children in Bogota, Colombia. Am J. Publ. Health., 99,94–101.
Miguel, E., Kremer, M., 2004. Worms identifying impacts on education and health in the presence of treatment externalities. Econometr.,72, 159–217.
Oguntibeju, O., 2006. Prevalence of intestinal parasites in HIV-positive/AIDS patients. Malays. J. Med. Sci., 13, 68-73.
Quihui-Cota, L., Valenica, M.E., Crompton, D.W.T., Phillips, S., Hagen, P., Diaz-Camacho, S.P., Tejas, A.T., 2004. Prevalence and intensity of intestinal parasitic infections in relation to nutritional status in Mexican schoolchildren. Trans. R. Soc. Trop. Med. Hyg., 98,653-659.
Rozendale, J.R., 1997. Vector Control Methods for use by Individuals and Communities. Geneva, WHO., 337- 356.
Singh, H.L., Singh, N.D., Singh, Y.I., 2004. Helminthic infestation of the primary school-going children in Manipur. J Commun Dis., 36,111–6.
Solomon, A., 2006. Intestinal helminths and anemia in malaria endemic area, Areka, Wolyta Zone. Rev. Parasitic disease., 28, 2-5.
Tadesse, D., Beyene, P., 2009. Irrigation Practices and Intestinal Helminth Infections in Southern and Central Zones of Tigray. Ethiop. J. Health Dev., 23(1).
Tilahun, A., 2010. Study of the Association of Soil-Transmitted Helminthiasis with Malnutrition and Anemia among School Children, Debub Achefer District, Northwest Ethiopia. Faculty of Life Sciences. Addis Ababa University. P.42.
Walsh, A.L., 1998. Prevalence in Entamoeba histolytica infection. Ravdin JI (Ed.).
WAO., 2007. Wukro Administration Office Report.
Warren, K.S., Bundy, D.A.P., Anderson, R.M., Davis, A., Henderson, D.A., Jamison, D.T., Prescott, N., Senft., 1993. Helminthes infections. In, Disease Control Priorities in Developing Countries, Oxford, Oxford University Press. p. 131-60.
World Health Organization., 2007. WHO AnthroPlus software, software for assessing growth and development of the world's children. Geneva, WHO .
WHO., 2009. AnthroPlus for personal computers Manual, Software for assessing growth of the world's children and adolescents. Geneva, World Health Organization. (http,//www.who.int/growthref/tools/en/) accessed on May, 2011.
Worku, L., Solomon, G., 2007. Sanitary survey of residential areas using Ascaris lumbricoides ova as indicators of environmental hygiene, Jimma, Ethiopia. Ethiop. J. Health Dev., 21(1).
Wukro Districrt Agricultural Station., 2009
Yeneneh, H., 1994. Survey of intestinal parasites in Bure area, Illubabor, southwest Ethiopia. Ethiop. J. Health Dev., 8,29-35.