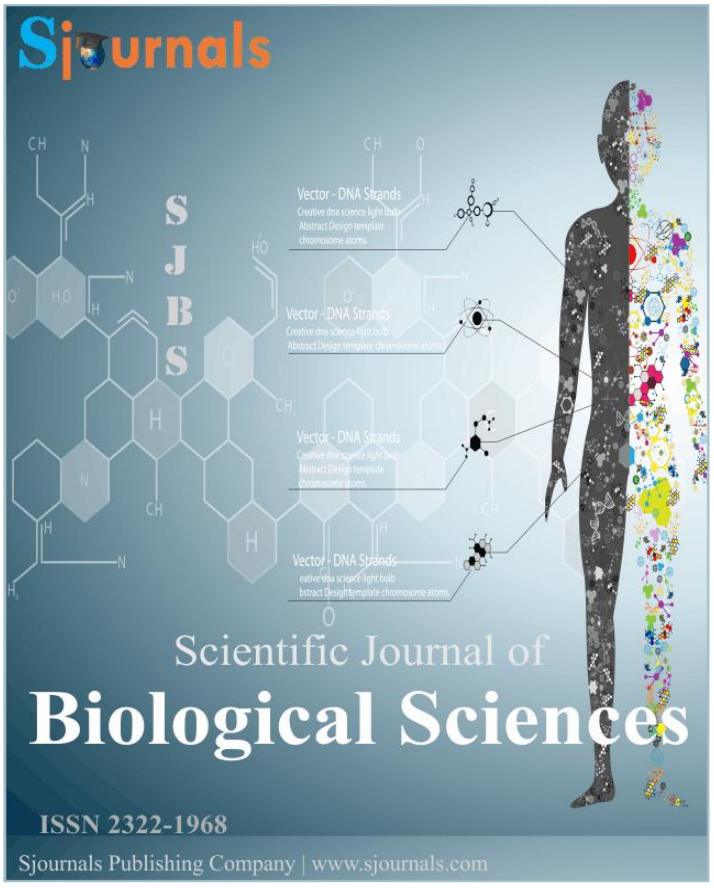
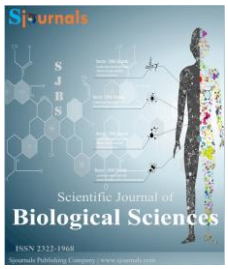


Sjournals
Scientific Journals

Scientific Journal of Biological Sciences (2016) 5(9) 174-183
ISSN 2322-1968
doi: 10.14196/sjbs.v5i9.2303

CODEN (USA): SJBSBH

Contents lists available at Sjournals
Scientific Journal of **Biological Sciences**
Journal homepage: www.Sjournals.com



Original article

Prevalence and associated risk factors for soil transmitted Helminth infections among Urban Dwellers, Amanuel Town, Northwest Ethiopia

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ARTICLE INFO

Article history,
Received 12 August 2016
Accepted 11 September 2016
Available online 18 September 2016
iThenticate screening 15 August 2016
English editing 09 September 2016
Quality control 15 September 2016

Keywords,
Amanuel
Helminthes
Infection
Prevalence
Soil

ABSTRACT

Infection by soil transmitted helminthes has been increasingly recognized as an important public health problem in poor and developing countries. To initiate prevention and control measures for these neglected diseases, adequate information is required among high risk group. The objective of this study was to determine the prevalence and associated risk factors for soil transmitted helminth infections among urban dwellers in Amanuel, east Gojjam, Ethiopia. A cross-sectional study, involving 403 individuals, was carried out in Amanuel between November 2010 and January 2011. A structured questionnaire and observation for demographic and associated risk factors for soil transmitted helminthes (STHs) infections were used for data collection. Stool samples were collected in plastic containers from each participant and transported to Amanuel Health center for parasitological examination. Both direct wet smear and former-ether sedimentation concentration techniques were used to determine the presence of helminthes eggs. The overall prevalence of STH infections was 46.2% (186/403). Hookworm infection was the predominant soil transmitted helminth infections, which was detected in 77(19.1%) followed by *A.*

lumbricoides which was infected 52(13%) of the study subjects. *T. trichuria* was the least prevalent geo-helminth infection, detected in only 23 (5.7%) of the study subjects. Majorities, 152(37.7%), had single infection. Double infection occurred in 25(6.2%) of the study subjects and only 9(2.2%) had multiple infection. The prevalence of soil transmitted helminthes was generally high in school age children and low in infants. The common predictors of STH infections in the study, among others, were poor personal hygienic conditions, less frequent wearing shoes habit, soil contacting occupation risk, and lack of hand washing habit after using toilet. On the basis of this result, it can be concluded that STH infection is an important problem among the community of Amanuel town. Therefore, it is recommended that education on personal and environmental hygiene should be taken into account to reduce the prevalence of STH infections. Moreover, school age children and other risk groups should receive regular treatment to control the transmissions of STH infections.

1. Introduction

Infection by Soil Transmitted Helminthes (STHs) has been increasingly recognized as an important public health problem, particularly in developing countries (Yeshambel et al., 2010), including tropical and sub tropical areas of sub-saharan Africa, Asia, and Latin America; the World Health Organization (WHO, 2012) estimates that more than two billion of the world's population is infected with STH. The three major Soil-Transmitted Helminths (STH), *Ascarislumbricoides* (roundworm), *Trichuris trichiura* (whipworm) and *Necator americanus/Ancylostoma duodenale* (the hookworms) are amongst the most widespread parasites worldwide (Vercruysse et al., 2011). More than a billon people were infected with one or more of these helminthes, accounting for up to 40% of the global morbidity from infectious disease (WHO, 2002). Infection is typically most intense and debilitating in school age children, resulting in malnutrition, physical and intellectual growth retardation, cognitive and educational deficits, reducing adult productivity and work capacity (Liabsuetraku et al., 2009). Worm transmission is enhanced by poor socio economic conditions, deficiency in sanitary facilities, and improper disposal of human faeces, poor personal hygiene, sub-standard housing, and lack of education (Stephenson et al., 2000). Intervention against these helminthiasis infections is based on regular anti-helminthic treatment; improvement of water supply and sanitation, health and education (Albonico et al., 2006).

The prevalence and transmission of soil transmitted helminthes varies in different geographical locations (Randall et al., 2003). Low and declined prevalence of soil transmitted helmintes (less thal 2%) in central America (Hotez et al., 2000), due to improved family income, maternal schooling, personal and environmental sanitation, housing and access to health care (Scolari et al., 2000). However, the prevalence of these helminthes in developing nation including Asia and Africa has been high and range between 30-60% (Hotez et al., 2004). In east Africa prevalence rates tend to be lower in the relatively drier and less humid coastal areas than elsewhere; in the hot dry areas of Somalia for instance, prevalence rates of soil transmitted helminthes was less than 5% (Peltola et al., 1995), whereas in the more humid southern areas the prevalence was reached 14-33% (Magnussen et al., 1998).

In Ethiopia the overall prevalence of hookworm infection was estimated to be 16% and prevalence rates of *Ascaris lumbricoides* and *Trichiuris trichiura* were reported to be 37% and 30% respectively (Tadesse et al., 2008). A study carried out by Yeshambel et al. (2010) also showed an association between demographic structure and life style of the population with the prevalence of soil transmitted helminth infections in Butajira, Ethiopia. No studies have been conducted on prevalence and risk factors for soil transmitted helminth infections among urban dwellers in Amanuel town. Therefore, the objectives of this study were to determine the determine the epidemiological

information on the prevalence for soil transmitted helminth infections and associated risk factors among urban dwellers in Amanuel.

2. Materials and methods

2.1. Description of the study area

The study was carried out in Amanuel capital city of Machakel woreda, East Gojjam, Ethiopia. The Town Amanuel lies at a distance of 327 km from Addis Ababa, capital city of Ethiopia, The altitude is 2468m above sea level with an area of 73.7 square kilo meters. The town had annual rainfall of 1380mm with a mean temperature of 18.5^0 C. Based on figure published by Central Statistical Agency (CSA) in 2005, the town had total populations of 10,325 from which 5,162 and 5,163 were males and female individuals respectively.

2.2. Study subjects

All residents of the town were included as a source of sample population for the study. The study population included residents of Amanuel town of both sexes and all ages; individuals who were on anti-helminthic drugs at the time of study or two weeks prior to the study were excluded.

2.3. Sample size

To determine the prevalence of STHs, 403 individuals were participated throughout the study period.

2.4. Study methodology

Household survey was used to collect stool sample and to determine the absence or presence of STHs infections among individuals, microscopic diagnosis was used

2.5. Study design

A cross-ectional study was conducted among urban dwellers lived in Amanuel town. The town has one administrative district and divided into six small villages. All the villages were given equal chance for data collection. In line with study subjects were selected using simple random sampling method by random strata, and sample size was determined by a general formula considering the level of significant at 5% and assuming the prevalence of soil transmitted helminthiasis in the town to be 50%. The minimum number of the sample size was determined using the statistical formula of sample size determination as:

$$n= Z^2 p (1-p)/d^2$$

Where, n= the number of the sample size

Z= 1.96 at 95% confidence interval

p= Prevalence rate of soil transmitted helminthes (in the study area)

d= margin of error assumed to be (0.05)

Then, $n=1.96^2\ 0.5(1-0.5)/0.05^2=384$

By adding 5% contingency (19 persons), a total of 403 subjects were included.

2.6. Stool examination

Stool samples were collected from November 2010 to January 2011. Parallel with stool collection, questionnaires were distributed to obtain information on age, sex, education level, and occupation and other necessary information such as toilet use, wearing shoe frequency, income, and living standards. Personal information of infants and pre school children was gathered from their families. All information's recorded by pre prepared format. The stool specimens were collected in plastic container from each participant. Stool specimens were transported to Amanuel Health Center with 8% formalin for microscopic examination. Four hundred three stool specimens were examined in the laboratory of Amanuel health center, Amanuel, using both direct thin wet smears in normal saline and formal-ether concentration sedimentation techniques. The eggs of each STH parasite were identified by their shape, shell, and color. The data from observation were matched with information on separate sheet with multiple infections.

2.7. Data analysis

All raw data generated from this study were coded and entered in to MS Excel 2010 database system and analyzed using SPSS windows version 19.0 soft ware package computer program. C Descriptive statistics such as Chi-square test (χ^2) was used to give a clear picture of characteristics and to observe the association between risk factors and prevalence of soil transmitted helminth infections. This was presented at 95% level of confidence ($p<0.05$) statistically significant.

3. Results and discussion

3.1. Stool examination

Of the total 403 individuals that were participated in the study, 186 (46.2%) were infected with one or more soil transmitted helminth infections. A total of 78 males and 108 females were positive for STH infections (Table 2). Two hundred seventeen (53.8%) had no infection at all.

3.2. STHs

Hookworm infection was the predominant soil transmitted helminth infections in this study, which was detected in 77 (19.1%) of study subjects and *Ascaris lumbricoides* was the second most frequently detected soil transmited helminth infection, detected in 52 (13%) (Table.1). *Trichiuris trichuira* was the least prevalent geo-helminth in this study, detected in only 23 (5.7%) of the study subjects (Table 1). Of the population sampled, 152 (37.7%) had single helminth infection, double infection occurred in 25 (6.2%) and only 9(2.2%) had multiple helminth infections. The most frequent combination of helminthes diagnosed in a single person were double infection of *A. lumbricoides* and hookworm 11(2.7%) and followed by triple infection of *A. lumbricoides, T. trichiura* and hookworm 9(2.2%) and the least frequent combination of helminthes were double infection of *T. tichiura* and hookworm 6(1.5%) followed by *A. lumbricoides* and *T.trichiura* 8(2%) (Table.1).

3.3. STHs based on age and sex

Ascaris lumbricoides and *Trichiuris trichiura* were the most common STH infections with prevalence rate of (33.3%) and 16.7%, respectively in preschool children and hookworm was the most prevalent (24.8%) and 18.3% in school age children and adults, respectively (table 3). Statistical analysis showed that there was a significant difference between the infection rates in the two sexes in which females were more infected than males ($p= 0.02$, Table 2) and schoolage children were more infected than the other age group ($p< 0.01$, table 2).

Table 1
Prevalence of soil transmitted helminthes among urban dwellers for the study subjects (N=403) in Amanel, east Gojjam 2010/11.

Soil transmitted helminthes	Frequency	Percentage
Single infection		
A. lumbricoides	52	13
T. trichiura	23	5.7
Hookworms	77	19.1
Double infection		
A. lumbricoides and T. trichiura	8	2
A. lumbricoides and hookworm	11	2.7
T. trichiura and hookworm	6	1.5
Multiple infection		
A. lumbricoides, T. trichiura and hookworm	9	2.2

3.4. STHs based on educational background

Analysis of educational background showed that illiterate were the most affected group infected mostly by hookworm (28.1%) whereas primary school students were highly infected with *A. lumbricoides* (26.9%) (Fig.1). The difference in infection rates between the two groups was statically significant in which primary school students

were more infected than illiterates (p= 0.004). There was also statistical significance difference between all educational backgrounds in infection rates for all geo-helminthes (p=0.004, Fig.1). In terms of occupation, governmental employees, merchants and housewives were highly infected by *A. lumbricoides* whereas private business, jobless, students, and farmers were highly infected by hookworm (Fig. 2). Farmers were more infected by hook worm than others (p= 0.01, Fig. 2).

Table 2
Prevalence of soil transmitted helminthes with relation to sex and age group for study subjects (N=403) in Amanuel, 2010/11.

Characteristics	Frequency (%)	Positive for helminthes (%)
Sex		
Male	202(50.1)	78(19.4)
Female	201(49.9)	108(26.8)
Age group		
<1	5(1.2)	1(0.3)
1-6	36(8.9)	21(5.6)
7-17	133(33)	83(20.6)
≥18	229(56.8)	81(20.1)

(<1=Infants, 7-17=School age children, 1-6=Preschool children and ≥=Adults).

Table 3
Age stratified prevalence of infection with soil transmitted helminthes among urban dwellers in Amanuel, east Gojjam, 2010/11.

			Helminthes		
Age(years)	No. of examined	No. of infected (%)	A.lumbricoides (%)	T.trichiura (%)	Hookworm (%)
<1	5	1(20)	1(20)	0(0.0)	0(0.0)
1-6	36	21(58.3)	12(33.3)	6(16.7)	2(5.5)
7-17	133	83(62.4)	24(18)	11(8.3)	33(24.8)
≥18	229	81(35.4)	15(6.6)	6(2.6)	42(18.3)

Table 4
Prevalence of soil transmitted helminthes for positive helminthiasis (n=186) among urban dwellers in Amanuel, 2010/11.

Types of helminthes	Frequency	Percentage
A. lumbricoides	52	28
T. trichiura	23	12.4
hookworm	77	41.1

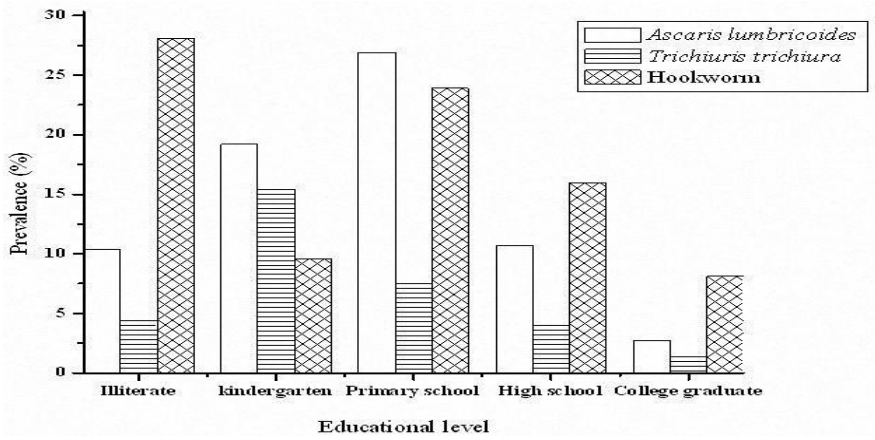

Fig. 1. Prevalence of STH in relation to education among urban dwellers in Amanuel, 2010/11.

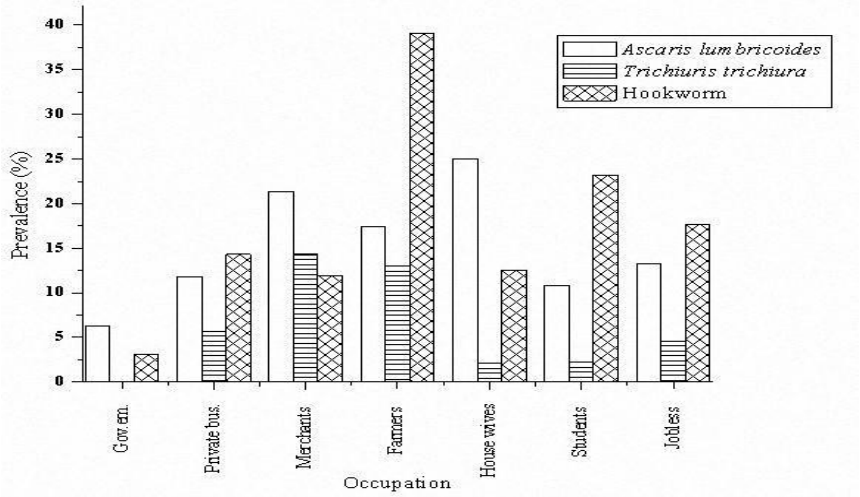

Fig. 2. Prevalence of STH in relation to occupation among urban dwellers in Amanuel, East Gojjam, 2010/11.

Table 5
Risk factors for the prevalence of soil transmitted helminth infections in relation to helminth positivity among urban dwellers in Amanuel, East Gojjam, 2010/11.

Risk factors	Frequency	Positive for helminthes (%)	P -value
Hand washing after toilet			
Yes	347	158(45.5)	0.043
No	56	28(50)	
Place of bathing			
Inside house	198	111(56)	0.003
Outside house	205	75(36.6)	
Place of defecation			
Inside latrine	315	134(42.5)	0.06
Outside latrine	88	52(59)	
Wearing shoe frequency			
Always	270	111(41)	
Some times	106	59(55.7)	0.014
Never	27	16(59.3)	
Personal hygienic condition			
Very good	74	13(17.6)	
Good	122	46(37.7)	0.000
Bad	207	127(61.4)	
Soil contacting occupation risk			
High risk	226	147(65)	0.000
Low risk	177	39(22)	

Soil transmitted helminthes were serious public health problems in several tropical countries with poor socio-economic status and personal hygiene. Ethiopia is one of such countries with high prevalence of STH infections. The transmission of these parasites is more common in school going children and is associated with high morbidity, mortality and economic loss to the country (Erko and Mingestu, 2004). Thus, knowledge of the distribution and extent of these neglected diseases in a given community is important to identify high risk group and design appropriate intervention program. To our knowledge, the present study was the first to be carried out in Amanuel, east Gojjam, that explored prevalence, transmission, and risk factors associated with soil transmitted helminth infections. The study found a high overall prevalence (46.2%) of STH infections among the residents of urban dwellers in Amanuel, east Gojjam. The prevalence was generally high in school age children and low in infants (table 2). The study revealed that high prevalence of hookworm infection (24.8%) and (18.3%) in school age

children and adults, respectively (Table 3). *Ascaris lumbricoides* dominantly infected infants and pre-school children. *T. tichiura* prevalence (16.7%) also was high in preschool children (Table 3). The high prevalence of feco-orally transmitted helminthes were recorded among the age group between 7 and 17 in this study might be closely related to their habits.

The study also showed that the nature of the occupation of individuals influenced the infection rates. For example, farmers were highly infected with STH infections than those with other types of occupation (p=0.01). A similar kind of finding was reported by Kunwar et al. (2006) in Lagos, Nigeria. The prevalence of STH infections in this study was; however, lower than other community based studies conducted among urban dwellers, in Jimma, southwest Ethiopia, by Mingistu et al. (2007) that showed an overall prevalence of 83%. This variation could be owing to climatic conditions and exposure to STH infection of the study subjects. But, the prevalence of STH infections in this study was higher than other community based study in Butajira, Ethiopia which showed an overall prevalence of 43.5% in mothers (Yeshambel et al., 2007). The prevalence of STH infections in the present study was also higher than the one reported (32.2%) from Saudi Arabia by Al Samari *et al.* (2001). This variation could be due to personal and environmental hygienic difference, economic, educational status of the study subjects and climatic conditions of the study area.

In this study, the overall prevalence of STH parasites among urban dwellers was higher than previous studies among food handlers done in Bahir Dar (41.3%) (Bayeh et al., 2010) and Gondar (29.1%) (Gashaw et al., 2008) in northwest Ethiopia. However, the prevalence in this study was lower than the study in Nepal (61.5%) in women (Comfort et al., 2008) and this difference might be due to soil characteristics of the study area, altitude, micro ecology, and variation in host behaviors might have contribute to the prevalence difference. Compared to the prevalence of 83.3% reported in rural community of Lagos, Nigeria, STH infections in the study subjects in the present study were lower. This difference was because of living area of study subjects, feeding habit, geographical variation, climatic difference and environmental conditions. In this study, the overall prevalence of STH helminth infections was lower than the previous study conducted around Lake Zeway Island in which overall prevalence of 56.7% reported (Tesfa-Michael and Ayele, 1983). But the prevalence of STH in the present study was a little bit higher than previous study in Abosa, around Lake Zeway with an overall prevalence of 43.3% reported by Solomon (2008). The lower prevalence obtained in the present study in comparison with reported by Tesfa-Michael and Ayele (1983) could be attributed to availability of latrine, education level and living standards of study subjects.

The prevalence of hookworm infections in this study was 19.1% which was higher than the findings of previous community based study in Jimma (17.5%) (Mingistu et al., 2007) but, the prevalence rate of hookworm infection in this study was lower than previous studies 53% prevalence in Nepal among women, 45% in Lagos, Nigeria among rural communities and 36.4% in Butajira in mother and their infants. The prevalence rate of hookworm in this study was higher than the prevalence rate of 8.1% and 1.6% among food handlers done in Bahidr Dar and Gondar, respectively and prevalence rate of 14.1% in Abosa, around Lake Zeway. In this study, females were more infected by hookworm than males and this might be due to the spend of time by females on muddy and wet place, which is suitable for infective larval stage (L3) of hookworm was higher than those of males. The prevalence of hookworm in the present study was high in farmers this was due to farmers spend more time in their farm which is suitable for infective larval stage of hookworm. The prevalence of hookworm in infants in this study was much lower (none of infected) than those found among one year old in Jimma, Ethiopia (hookworm, 13.3%) (Dagoye et al., 2003). The lower prevalence of hookworm in infants in this study was probably due to infants had no direct contact with soil. Unlike *Ascaris* and *Trichiuris,* in this study the high prevalence of hookworm was seen among the older age and school age children age 7-17 and low in the infants and youngest age group 1-6. Similar findings had been reported from schoolage children in other studies in southeast of Lake Langano (Erko and Mingistu, 2004). This phenomenon might be reflects age related change in exposure to STH infection.

Two hundred and seventy (67%) participant had always shoes wearing habit. In hookworm infection analysis of variance showed that not wearing shoes was the risk factor and statistically significant difference was also observed between individuals with and without shoes. Individuals who never wore shoes were infected by hookworm 5 times more than who wore always (p=0.014). The association between walking barefoot and rate of infection in this study was similar to the result of other study done in Abosa, Ethiopia (Solomon, 2008). The hookworm infection reported here was not differentiated in to species level since it is impossible to differentiate without stool culture. As both *Ancyclostoma duodenale* and *Necator americanus* have a wide distribution in Ethiopia (Jemaneh and Ayle, 1986), it is expected that both species might be present in Amanuel, east Gojjam.

In this study 52 (13%) of the study subjects were infected with *A. lumbricoides* and this prevalence rate was lower than the nationwide prevalence rates of (30-40%) of ascariasis (Tedla and Ayele, 1986). In the present study area *Ascaris* infection was the second most frequently encountered geo- helminth and was formed to infect highly preschool children High positive rate of *A. lumbricoides* was recorded in preschool children in the present study because of the dirty environment in which they played and contaminate their hands and dip their hands into the mouth quite often. *A. lumbricioides* eggs are very resistance to harsh environmental conditions and air borne. They may account for the ubiquitous nature of egg distributions and hence high prevalence of ascariasis was observed in the present study (Table 3). There was a significant association between hand wash practice and infection by *Ascaris.* Three hundred and forty seven (86%) of the study subjects had the habit of washing hand after toilet. There was significant difference of infection rate of STH between individuals who did and did not wash hand after toilet. Statistical analysis showed that individuals who did not wash their hand after toilet were 1.8 times infected by *Ascaris* than who washed their hands (p= 0.014)

The prevalence of *T. trichiura* in this study was 5.7%, which was higher than previous studies reported prevalence rate of 0.52% and 0.8% among food handlers done in Bahir Dar and Gondar, respectivelly and prevalence rate of 3.3% and 0.4% in mother and their infants, respectively in Butajira, Ethiopia and 2.7% in women in Nepal, however, the prevalence of *T. trichiura* in this study much lower than the previous studies in which prevalence rate of 60.9% among urban dwellers in southwest Ethiopia and 32.3% among rural community in Lagos, Nigeria respectively were reported. Multiple soil transmitted helminth infections were less common in this study than other studies reported in Ethiopia. For example, study in Wondo-Genet area reported 40% of the population to be infected with two helminth parasites and 3% with four helminth parasites (Erkol and Medhin, 3003). Such difference might arise from difference in the study subjects, socio demographic condition of the society or difference in parasitological examination techniques, personal and environmental hygienic condition of the study subjects.

The low prevalence of some parasites (*A. lumbricoides* and *T. trichiura*) among older groups in this study may reflect a positive change in the hygienic behavior. The present study was identified key environmental factors linked with the prevalence and distribution of soil transmitted helminth infections. Poor personal hygienic conditions, less frequent shoes wearing habit, place of bathing, not toilet use to defecate, soil contacting occupation and lack of hand washing habit after using toilet were found to be the common predictors of soil transmitted helminth infections (Table 5). There was no significant association between place of defecation and infection rate of soil transmitted helminth infections (p=0.06) in this study. The more availability of toilet, unless properly used, does not necessarily guarantee protection against STH infection.

4. Conclusion

In conclusion, soil transmitted helminthiasis in Amanuel town was relatively high. Hookworm infection was the most frequently encountered geo-helminth that infected predominantly farmers and school age children. School age children were more infected by STH than the other age groups in the town. The high prevalence of helminthiasis in the study areas indicated that much work remains to be done to improve the health of the people. Therefore, it can be concluded that STH infection is prevalent in Amanuel and intervention strategy should be designed and be implemented for this neglected disease. So, based on the findings of the present study, it can be recommended that local health authorities should teach the local community how to improve personal and environmental hygienic conditions. Further more, health education and public latrine construction should be initiated by the community and responsible governing bodies to tackle the problem. Regular treatment of school-age children and other groups at risk such as preschool children, adults and special occupation groups may help avoiding the worst effect of STH infection. In the present study, it was difficult to conclude that zero prevalence of hookworm and *T. trichuira* in infants only due to no direct contact with soil. So, further studies must be conducted before any conclusion can be made. This survey demonstrated a high prevalence of hookworm in the town and further studies are required to determine what species of hookworm is endemic in this area.

Acknowledgements

The authors would like to thank the Ministry of Education of Ethiopia for funding this study and Bahir Dar University also acknowledge for assisting us for laboratory facilities.

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How to cite this article: Enawgaw, Y., Sisay, A., Nibret, E., 2016. Prevalence and associated risk factors for soil transmitted Helminth infections among Urban Dwellers, Amanuel Town, Northwest Ethiopia. Scientific Journal of Biological Sciences, 5(9), 174-183.