

Soil Transmitted Helminthes Prevalence among Pre-School Age Children in Elburgon Municipality, Kenya

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ABTRACT
The prevalence of soil transmitted helminthes infection in pre-school age children was assessed in Elburgon Municipality, Kenya using Kato Katz as the standard parasitological survey diagnostic technique. Children between 6 months and 5 years were examined for STH infections. Out of 179 children examined, 154 (86%) were positive for the STH studied with *Trichuris trichura* accounting for the highest infection with 91 (50.84%), *Ascaris, lumbricoides* 45 (25.14%), and hookworm 18 (10.06%). Multiparasitism was evident with an overall 48 (28%) infection with a combination of two or three of the STH species studied. The high STH prevalence reported in this study was a result of unhygiene living environment with conditions that facilitate STH infections and transmission. *T. Trichura* had the highest prevalence because this is an urban STH species as compared to *A. lumbricoides* and hookworm. STH in pre-school age children is a virgin field in helminthes control. Mass deworming programs and parental education are required for effective STH control in this age group population that other is most vulnerable to helminthes infection.
Keywords: soil transmitted helminthes, pre-school age children, prevalence, kato katz

1.0Introduction

Soil transmitted helminthes are a group of intestinal helminthes comprising of *Ascaris lumbricoides*, *Trichuris trichura* and hookworm (*Ancylostoma duodenale* and *Necator americanus*). The World Health Organization groups these infections under neglected tropical diseases (NTD) that infect poor populations confined to the tropics (Albonico *et al*, 2008). The greatest burdens of these infections are found in Tropical South America, East Asia, China and Sub-Sahara Africa (Saboya *et al*, 2011). Kenya in East Africa is has an estimated population of 9.1 million people at risk of STH infection. Approximately 2.37 million of the populations at risk in this country are children**.** The high prevalence of STH in Kenya is directly associated with poor environmental and personal hygiene and sanitation. Studies show that the prevalence distribution pattern indicates children from low-income families both urban and rural living in compromised unhygienic environments are always at risk of STH infection (Gunawardena *et al,* 2008). Morbidity from STH infections manifests on children of 6-24 months of age and young mothers (Vera *et al*, 2005). Among the three intestinal helminthes considered together, *A. lumbricoides* is the most common and infects the highest number of victims while hookworm is reportedly causing the most severe morbidity characterized by high anaemia (Burns, 2010). With STH infections, transmission and infections will be high in area with victims that bear the heavy infections of any particular species. Heavy infections mean that, a particular species will have the highest number of viable eggs in the soil that will either hatch to grow the infective larvae for hookworm or many eggs will be available in the soil for contact with victims and eventually swallowing for *A. lumbricoides* and *T. trichura* (McCarthy *et al,* 2012)**.**

STHs are among NTDs. These infections are neglected because they receive the little attentions from stakeholders such as funders, researchers and government institution. Although STH are not among the biggest diseases killers, their chronic infections cause morbidity in children that affects cognitive development and growth (Friedman, 2012; Knopp *et al*, 2008). These effects are severe in younger populations. Surprising, the younger population receive little attention from programs such as mass deworming that are directed towards control and elimination performed in school going children. As infections of great public health challenge, treatment efforts are targeted towards control and elimination. WHO through the World Health Assembly passed a resolution in 2001 to urge endemic countries to adopt large-scale deworming programs using anti-helminthic drugs that are easier to administer (Bethony *et al*, 2006). Currently, large-scale deworming programs through primary school population have been reportedly effective in controlling these infections in developing countries. Periodic mass deworming has been reportedly effective where the governments of endemic conduct treatment in primary school going children (Zhang *et al*, 2007).

2.0MATERIALS AND METHODS

2.1 Study area

This study was conducted in Elburgon Municipality, located in Nakuru County, Kenya from August 2013 through March 2014. Elburgon lies approximately 0^0 18' 0" South, 35^0 49' 0" East. It has a population size of

90,000 with approximately 20,000 households. It has a warm and cool climate with an average annual temperature of 14.3^{0}C and 1126 mm rainfall. The economic activities of its residents include farming, forestry and live stock keeping. The semi urban households were selected for the study.

2.2 Ethical approval
The permission to conduct this research was granted by Egerton University Ethics Research Committee through the Division of Research & Extension. The ethical clearance was given subject to the following key conditions: ensuring confidentiality for the participants and ensuring professionalism in collection and disposal of feacal sample and reporting to the committee the progress of the research on a quarterly basis.

2.3 Study population
The target population for this study was pre-school age children living in semi urban homes within the study area. Inclusion criteria were children aged 6 months to 5 years, children who had not received STH treatment within three months prior to the study.

2.4 Faecal sample collection
Carers of children enrolled in this study were provided with plastic bags and sample stool caps. Stool caps were labeled with codes identifying the child and the household number. Carers were instructed how to safely collect faecal samples from children during their first health break of the day. The collected samples were transported to the Elburgon sub district hospital laboratory for analysis using a cooler box containing ice packs.

2.5 Laboratory analysis
Kato Katz technique was used for STH eggs identification. Stool physical characteristics including solid, semisolid and watery was analyzed to determine if the sample was in a good state for processing (WHO, 2000). Slides were labeled to correspond with the labels in the sample stool cap. The standard operating procedures for Kato Katz technique were used to prepare the slides. Prepared slides were examined under x4 objective lens under the microscope to scan for hookworm egg within the first hour of slide preparation ((Arcari *et al*, 2000; Levecke *et al,* 2011). Egg counting was accomplished using tally counting technique.

2.6 Statistical analysis
Descriptive statistical methods using Microsoft Excel 2007 program was used for result analysis.

3.0 RESULTS
3.1 Overall prevalence
Out of 179 children who completed the study, 154 (86%) were positive of any STH infection and 25 (14%) did not show any evidence of infection as shown in figure 1.

3.2 Parasite specific prevalence
T. trichura had the highest infection prevalence followed by *A. lumbricoides* and hookworm with 91 (50.84%), 45 (25.14%), 18 (10.06%) case prevalence respectively as shown in figure 2.

3.3 Multiparasitism
Infection with more than one parasite was evident in the stool sample examined with 43 (28%) case prevalence. *T. trichura* and *A. lumbricoides* had the highest combination prevalence followed by Hookworm and *T. trichura,* hookworm and *A. lumbricoides* and the infection with the three parasites having the lowest prevalence. Tri-parasitism and bi-parasitism were recorded as shown in figure 3.

3.5 STH parasitic burden
Parasitic burden is associated with the intensity of parasite infections in cases studied. *A. lumbricoides* had the highest number of parasite eggs in one individual, which interprets to heavy infection. *A. lumbricoides* had the highest number of eggs with an average of 34851.7 EPG of faeces examined. *T. trichura* and hookworm had an average of 48.8 and 45.3 EPG of faeces examined respectively. 39 (21.8%) case prevalence had heavy infection with *A. lumbricoides* while *T. trichura* and hookworm did not have evidence of heavy infection. The three parasites had light infections as summarized in table 1.

4.0 Discussion
In this study, the prevalence of STH in Elburgon Municipality was high 86%. The three species of STH *T. trichura*, *A. lumbricoides* and hookworm were present in stool samples examined. *T. trichura* had high frequency of infection followed by *A. lumbricoides* and hookworm. Results in this study illustrate the general trend of STH

infections in pre-school age children in similar environment in endemic areas. The common trend of STH infection in similar household is due to similarities in environmental conditions described as having a presence of raw sewage where children spend most of their time (Ezeagwuna *et al*, 2009). The findings in this study that indicate the trend in infection of the three helminthes are similar to those obtained in the same age group in National survey study in Philippines (Belizario *et al*, 2013). The high prevalence of STH in Elburgon Municipality is close to the prevalence (74.4%) reported in a similar study in and a similar environment in Webuye, Western, Kenya from children below five years (Obala, 2013).

The observed high prevalence of STH in endemic areas have a common trend of environmental conditions and are usually associated with indiscriminate raw sewage disposal, poor household sanitation, unhygiene environment and low household living standards in developing countries that hardly embrace hygiene (Mwinzi *et al*, 2012). Young children below five years are highly vulnerable for STH infection in semi urban area because they have a high level of contact with contaminated soil in their playground. Since children in semi urban slams have restricted and monitored health break, they will more likely have the behavior of defecating anywhere in the open (Ng'etich *et al*, 2013). If these children are infected with STH, their stools harbor eggs that will be spread though out play ground within few days. STH eggs are adhesive and will tend to stick in many objects that come into contact with the soil. Children play in groups and they will tend to lay hand on every object they come across hence making transmission easy and effective. *A. lumbricoides* eggs have a high capacity to withstand environmental conditions hence making them available for long (Uneke *et al*, 2006). The presence of infected victims and conducive environment for transmission are associated with reported high prevalence.

This study revealed that *T. trichura* had high infection than the expected *A. lumbricoides*. Quite often, STH studies report *A. lumbricoides* to have the highest infection rate than the *T. trichura* but hookworm prevalence in these studies has always been ranked third (Scolari *et al*, 2000). The high *T. trichura* prevalence in Elburgon Municipality agrees with numerous data that has investigated STH in urban areas. *T. trichura* tends to be an urban STH where overcrowding is inevitable. This helminthes is most often prevalence in crowded place where it occurs. While one person in a family can be infected with *A. lumbricoides* or hookworm, other member will not necessarily get infection. The trend for these two helminthes is different from *T. trichura*. With this parasite, if one member of the family has an infection, all other members will most likely be infected. When treating STH where *T. trichura* is prevalent, it is important to treat the whole family (Riesel *et al,* 2010; Odiere *et al,* 2011). The mechanism of *T. trichura* infection explains why this helminth is in high prevalent in urban areas where households are crowded such as semi-urban slums in Elburgon Municipality.

The high prevalence of STH in the area of study is also associated with lack of control programs targeting young children. In Kenya, school going children receive mass deworming as government programs targeted towards control and elimination of STH. Additionally, donors and funders tend to target mass deworming programs that are effective in controlling STH but these programs are only done in school going children (PAHO, 2011; Albonico *et al,* 2008). Lack of similar programs that target PSAC are lacking in developing and endemic countries hence living this population age group vulnerable to STH infection.

Polyparasitism was evident in this study and occurred in 43 (28%) case prevalence. The mixed parasites that were harbored in one individual were likely to be *T. trichura* and *A. lumbricoides* or *T. trichura* and hookworm. *T. trichura* was observed to pair with the other two helminthes because it had the highest frequency. STH studies for both PSAC and SAC often report that those found positive usually harbor more than one parasite. Polyparasitism is common in STH studies and researchers generally agree that multiparasitism is a global norm occurring in endemic areas (Belyhun *et al,* 2010; Uneke *et al,* 2008).

Parasite intensity was analyzed in this study and *A. lumbricoides* was observed to have the highest intensity with evident eggs >50,000 and occurred in 39 (21.8%) cases. Light infection (eggs <5000) with this specific parasite occurred in 6 (3.4%) cases. Infection intensity with *T. trichura* and hookworm was low and no moderate helminth intensity was observed with all the three helminthes. Research studies have shown that approximately 15% of human populations with STH harbor heavy infections in any given endemic area (PAHO, 2011). In this study, the prevalence with heavy infections was slightly high than the 15% human population assumption who harbor infection with STH. Individuals with heavy infection develop morbidity and will likely show clinical symptoms. Even though *A. lumbrocoides* is reportedly having low harm than hookworm especially when heavy infection is present, the combined effects of these parasite when in one individual weather heavily, moderately or lowly infected results to stunted growth, malnutrition and negative effects on cognitive development (Albonico *et al*, 2008; Wang *et al*, 2012). Apart from morbidity, heavy infection is associated with high transmission for the parasite involved. Interestingly, the few highly infected individuals are reportedly the main source of soil contamination (Mascarini-Serra, 2011). They will deposit high number of eggs in the environment. The high number of helminth eggs in the environment means that a large number will survive unfavorable environmental conditions hence being viable and available for transmission when children come into contact with them.

Soil transmitted helminthes is high among pre-school age children living in Elburgon Municipality. Children below five years remain a risk population for STH transmission and infection. Current mass deworming programs, which are widely published for controlling STH are targeted towards school going children living out PSAC. This population equally requires interventions and mass deworming campaigns against STH especially in crowded living household such as semi urban areas will be effective in reaching out to those children population who will not be enrolled in public schools. Effective treatment and control of STH in a certain age group while another age group remains unattended, assuming the two groups live in the same household does not minimize or eliminate transmission with these infections especially when *T. trichura* is a common parasite.

References

Albonico, M., Henrietta, A., Chitsulo, L., Dirk, E., Albis-Francesco, G., and Lorenzo, S. (2008). Controlling Soil-Transmitted Helminthiasis in Pre-School-Age Children through Preventive Chemotherapy. *PLoS Negl Trop Dis*. **2**(3): e126

Arcari, M., Baxenndine, A., and Bennett, C. (2000). *Diagnosing Medical Parasites Through Coprological Techniques.* SOUTHAMPTON: University of Southampton and Diasys Ltd.

Belizario, V. Y., Isidore, F. G., de Leon, W.U., Ciro, T. N. and Lumampao, Y. F. (2013). Sentinel Surveillance of Soil-Transmitted Helminthiasis in Pre-school Age and School-Age Children in Selected Local Government Units in the Phillipines: Follow-up Assessment. *Asia-Pacific Journal of public Health*. **26** (1). 2-3.

Belyhun, Y., Medhin, G., Amberbir, A., Erko, B., and Hanlon, C., Alem, A. and Venn, A. (2010). Prevalence and risk factors for soil-transmitted helminth infection in mothers and their infants in Butajira, Ethiopia: a population based study. *BMC Public Health.* **10** (21): doi:10.1186/1471-2458-10-21

Bethony, J., Brooker, S., Albonico M., Geiger, S., M., Loukas, A., Diemert, D. & Hotez, P. J. (2006). Soil-transmitted helminth infections:ascariasis, trichuriasis, and hookworm. *Lancet.* **367**: 1521-1532

Ezeagwuna, D., Okwelogu, I., Ekejindu, I. and Ogbuagu, C. (2009). The prevalence and socio-economic factors of intestinal helminth infections among primary school pupils in Ozubulu, Anambra State, Nigeria. *The Internet Journal of Epidemiology*. 9 (1).

Friedman, A.J., Ali, S.M., and Marco, A. (2012). Safety of a New Chewable Formulation of Mebendazole for Preventive Chemotherapy: Interventions to Treat Young Children in Countries with Moderate-to-High Prevalence of Soil Transmitted Helminth Infections. *Journal of Tropical Medicine.* **2012**. 7-8.

Gunawardena, N.K., Amarasekera, N.D., Pathmeswaran, A., and De Silva, N.R. (2008). Effect of repeated mass chemotherapy for filariasis control on Soil-transmitted helminth infections in Sri Lanka. *Cyclon Medical Journal.* **53** (1).

Knopp, S., Rinaldi, L., Simba Khamis, I., Stothard, R.J., Rollinson, D., Maurelli, M.P., Steinmann, P., Martif, H. Cringoli,G. and Utzinger, J. (2008). A single FLOTAC is more sensitive than triplicate Kato-Katz for the diagnosis of low-intensity soil-transmitted helminth infections. *Transactions of the Royal Society of Tropical Medicine & Hygiene*. **103** (4): 347-354

Mascarini-Serra, L. (2011). Prevention of Soil-transmitted Helminth Infection. *Journal of Global Infectious Diseases.* **3** (2): 175-182

McCarthy, J.S., Lustigman, S., Yang, G., Barakat, R.M., Garcia, H.H. Sripa, B., and Willingham, A.L. (2012). A Research Agenda for Helminth Diseases of Humans: Diagnostic for Control and Elimination Programmes. *PLoS Neglected Tropical Disease*. **6** (5): e1601

Mwinzi, P.N.M., Montgomery, S.P., Owaga, C.O., Mwanje, M., Muok. E.M., Ayisi, J.G., Laserson, K. F., Muchiri, E.M., Secor, E.W., and Karanja, D.M. (2012). Intergrated community-directed intervention for schistosomiasis and soil transmitted helminthes in western Kenya- a pilot study. *Parasite and Vector.* **5**:182

Ng'etich, E.C., Kihara, H. J., Odhiambo, O.R., Mwandawiro,C., and Swaminathan, P. (2013). The Burden of Multiple Infections with *Plasmodium falciparum*, *Schistosoma mansoni* and soil-transmitted Helminths among School Going Children in Kisumu, Kenya. *Science Journal of Medicine and Clinical Trials*. 2013: ISSN: 2276-7487

Obala, A.A., Simiyu, C.J., Odhiambo, D.O., Nanyu, V., Chege, P., Downing, R., Mwaliko, E., Mwangi, A.W., Menya, D., Chelagat, D., Nyamogoba, H.D.N., Ayuo, P.O., O'Meara, W.P., Twigirumukiza, M., Vandenbroek, D., Otsyula, B.B.O., and deMaeseneer, J. (2013). Webuye Health and Demographic Surveillance Systems Baseline Survey of Soil-Transmitted Helminths and Intestinal Protozoa among Children up to Five Years. *Journal of Tropical Medicine*. 2013(2013).

Odiere, M.R., Opisa, S., Odhiambo, G., Jura,W.G., Ayisi, J.M., Karanja, D.M., and Mwinzi, P.N. (2011). Georgraphical distribution of schistosomiasis and soil-transmitted helminthes among school children in informal settlements in Kisumu City, Western Kenya. *PubMed Parasitology.* **132** (12):1569-77.

Pan American Health Organization (2011). Prevalence and intensity of infection of Soil-transmitted Helminths in Latin America and the Caribbean Countries: Mapping at second administrative level 2000-2010. Washington, D.C.: PAHO 2011. http://www.paho.org/hq/index.php?option=com_docman&task=doc_view&gid=14333&Itemid

Riesel, J. N., Ochieng, F. O., Peter, W., Vermund, S.H., and Mario, D. (2010). High Prevalence of Soil-transmitted Helminths in Western Kenya: Failure to Implement Deworming Guidelines in Rural Nyanza Province. *Journal of Tropical Pediatrics.* **56**(1): 60-62.

Saboya, M. I., Catala, L., Nicholls, R. S., and Ault, S. K. (2011). Update on the Mapping of Prevalence and Intensity of Infection for Soil-Transmitted Helminth Infections in Latin America and the Caribbean: A Call for Action. *PloS Neglected Tropical Diseases*. 7(9): e2419. doi: 10.1371/journal.pntd.0002419

Scolari, C., Torti ,C., Beltrame, A., Matteelli, A., Castelli, F., Gulletta, M., Ribas, M., Morana, S. and Urban, C. (2000). Prevalence and distribution of soil-transmitted helminth (STH) infections in urban and indigenous Schoolchildren in Ortigueira, State of Parana, Brazil: implications for control. *Tropical Medicine & International Health*. **5**(4): 302-307

Uneke, C., Mnachi, M., Arua, U. (2008). Assessment of polyparasitism with intestinal parasite infections and urinary schistosomiasis among school children in semi-urban area of south eastern Nigeria. *The Internet Journal of Health* **9**(1).

Uneke, C., Eze, K., Oyipo P., Azu, A. and Ali, E. (2006). Soil-Transmitted Helminth Infection In School Children In South-Eastern Nigeria: The Public Health Implication. *The Internet Journal of Third World Medicine*. **4**(1).

Vera, J., Mile, B., Joanita, F., Esme, J., Bronwyn, M., and Dhansay, A. (2005). Paradoxical helminthiasis and giardiasis in Cape Town, South Africa: Epidemiology and Control. *Africa Health Sciences*. **5**(2).

Wang, X., Zhang, L., Luo, R., Wang, G., Ghen, Y., Medina, A., Eggleston, K., Rozelle, S., and Smith, D.S. (2012).Soil-Transmitted Helminth Infections and Correlated Risk Factors in Preschool and School-Aged Children in Rural Southwest China. *PLoS ONE.* 7(9): e45939

World Health Organization (2011). Intestinal worms: Soil-transmitted helminths. Retrieved on 30 March 2013 from http://www.who.int/intestinal_worms/en/

World Health Organization (2000). The Kato Technique: How the Kato Katz technique works. Retrieved on 28 March 2013 from www.who.int/neglected_diseases/en/

Zhang, Y., Koukounari, A., Kabatereine, N., Fleming, F., Kazibwe, F., and Tukahebwa, E. (2007) Parasitological impact of 2-year preventive chemotherapy on schistosomiasis and soil-transmitted helminthiasis in Uganda. *BMC Medicine Academic Journal*. **5:** 27

FIGURES

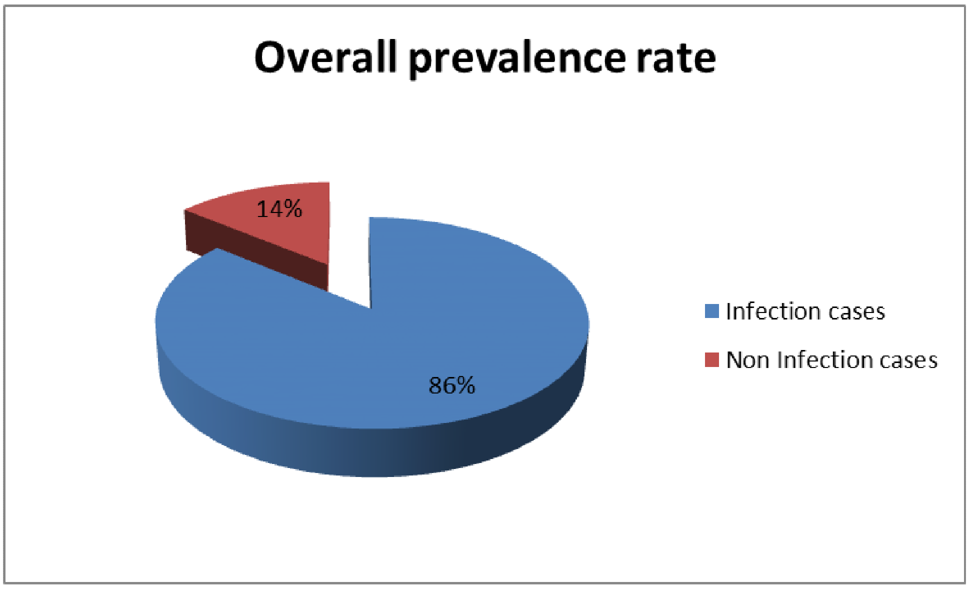

Figure 1: Overall infection prevalence of the 179 children

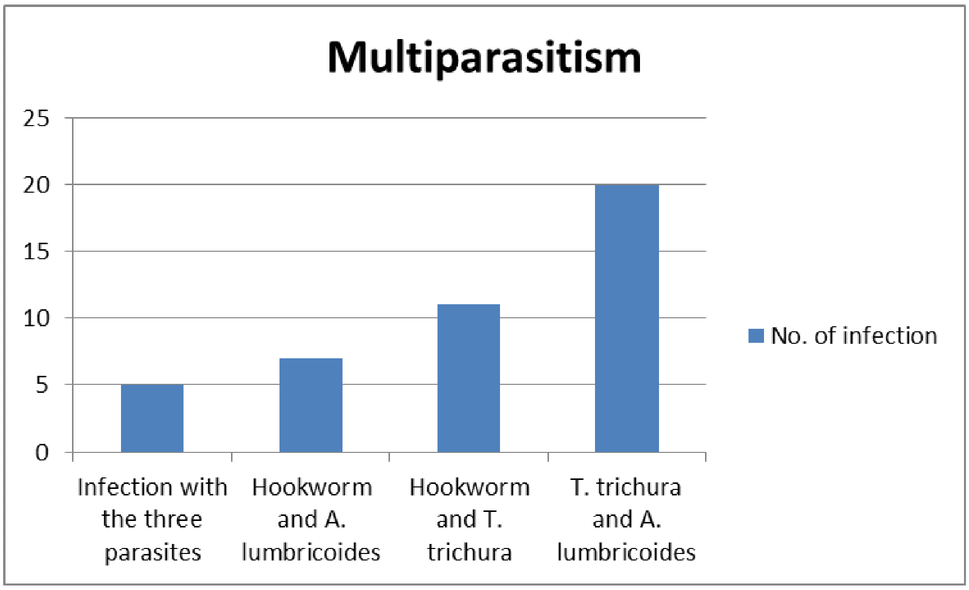

Figure 2: Multiparasitism infection trend

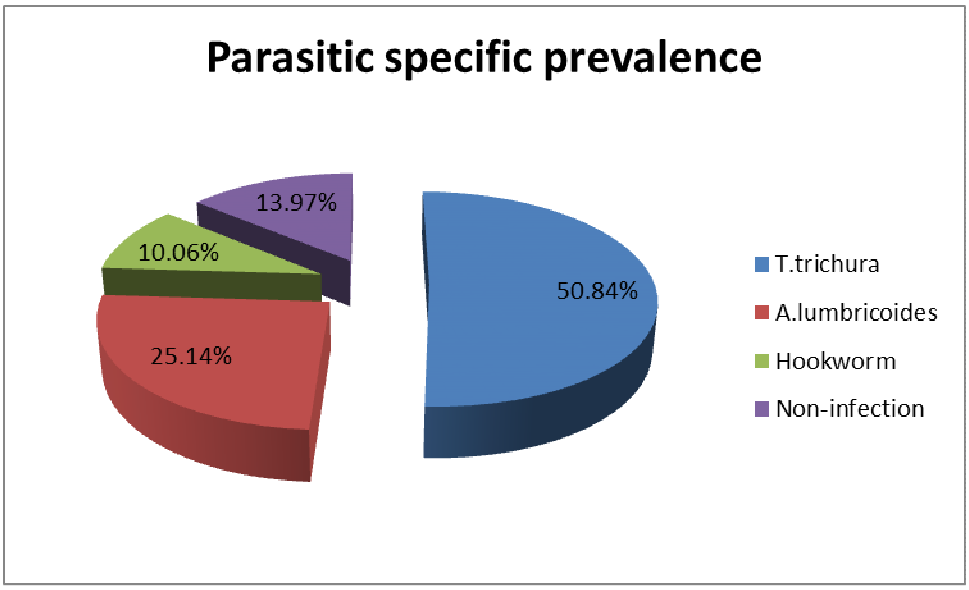

Figure 3. Individual parasite infection prevalence

Table 1: Mean EPGs and parasite intensity for helminths species.

			Types of helminth infection intensity		
Parasite species	Mean EPG	Maximum EPG	Light	Moderate	Heavy
T. trichura	48.8	144	91(50.84%)	0(0%)	0(0%)
A.lumbricoides	34851.7	64824	6 (3.4%)	0(0%)	39(21.8%)
Hookworm	45.3	120	18 (10%)	0(0%)	0(0%)