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Short Communication: The diversity of intestinal parasitic helminths in children of Silvercity, Linden, Guyana

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Abstract. *Arthur-McKenzie J, Ansari AA. 2018. Short Communication: The diversity of intestinal parasitic helminths in children of Silvercity, Linden, Guyana. Biodiversitas 19: 1289-1293.* This study was conducted in the Silvercity area, Linden, Guyana and endeavored to determine the prevalence of intestinal parasitic helminths in children aged 5-15 and the level of awareness of these parasitic infections among community members. Questionnaires were distributed to 30 households and 26 children which accounts for 40% of the population aged 5-15 using a simple random sampling method and tested during the months of February-April 2017. The fecal samples were collected from 26 children selected randomly and were analyzed using wet mount and formalin-ether sedimentation method. The highest age was 15 and the lowest 5, the mean age was 8. The results showed that there was a 57.6% (15/26) prevalence of intestinal parasitic helminths among children aged 5-15 within the Silvercity area. Among the parasites found, *Ascaris lumbricoides* was the most prevalent (38%; 10/26) followed by *Enterobius vermicularis* (19%; 5/26), *Trichuris trichiura* (15%; 4/26) and hookworm (3.8%; 1/26). Study also found that the level of awareness of transmission among community members was 40%.

Keywords: Age, children, diagnosis, helminths, Linden

INTRODUCTION

Parasitic helminths are the most common infectious agents of humans in developing countries and usually belong to the Phyla Nematoda, Cestoda, and Trematoda. Among these, Phylum Nematoda contains the most common intestinal parasitic helminths worldwide. These include the soil-transmitted helminths along with *Enterobius vermicularis* (Hotez et al. 2008). The soil-transmitted helminths alone account for 2 billion infections worldwide of which 880 million are children (WHO, 2017). Infections are especially prevalent within the tropical and sub-tropical developing countries of South and Central America, Asia and Africa (Baron, 1996). A tremendous amount of research has been conducted in these areas on the prevalence of intestinal helminths, particularly in Africa and Asia and a few Latin American and Caribbean countries. It was found that prevalence in most of the Latin American and Caribbean countries is high and 35.4 million school-age children are estimated to be at risk of infections by soil-transmitted helminths in these areas (Saboya et al. 2013). Prevalence rates for these countries include Columbia, in which there is an 84% prevalence (Salcedos-Cifuentes et al. 2012), 89.6% in Argentina (Gamboa et al. 2014), 93 % in Nicaragua (Munoz-Antoli et al. 2014) and 43.5% in Guyana (Lindo et al. 2002). The sole study conducted in Guyana is not enough to make an estimate on the national prevalence and it is, therefore, evident that further studies should be conducted since the prevalence rates for Guyana is expected to be high based on its climate and developing status (Saboya et al. 2013).

The species-specific prevalence rates for soil-transmitted helminths in Latin America and the Caribbean sees *Trichuris trichiura* being the most prevalent with an overall prevalence of 19%, and approximately 100 million persons are infected. This is followed closely by *Ascaris* with a prevalence of 16% infecting more than 80 million people and Hookworms with the lowest prevalence rate at 10% infecting about 50 million people (PAHO, 2007). The morbidity caused intestinal helminths is related to worm intensity and the global burden of its diseases exceeds that of malaria and tuberculosis (Hotez et al. 2008). Untreated helminth infections can result in chronic inflammatory disorders that cause both concurrent and delayed onset pathology in the affected host (Budke et al. 2005; King, 2007). These infections often lead to insidious persistent health conditions such as anemia, stunted growth and reduced physical fitness, under-nutrition, fatigue and impaired cognitive development (Bethony et al. 2006). The subtle appearance of these morbidities causes them to be often overlooked and neglected. However, due to the rising prevalence of helminth infections in rural areas where health impairment is greatly magnified in terms of deterioration of individual patient performance status, these diseases are of great importance (King et al. 2008). Epidemiological research shows that the frequency and intensity of helminth infection rise in childhood and declines in adulthood.

Infections have been linked to social and economic development. Prevalence is often related to factors such as poverty, overcrowding, poor environmental conditions, lack of awareness and access to safe water (Mehraj et al. 2008). Of these factors, poverty is the most commonly associated with infection. According to Hotez (2008), helminthic infections are common in people who live on less than US $2 per day in Asia, Sub-Saharan Africa, and the Americas.

This study aimed to determine the prevalence of intestinal parasitic helminths in children and to determine the level of awareness about the transmission of these infections among community members.

MATERIALS AND METHODS

Research site

Linden (study area) is the second largest town in Guyana after Georgetown, and capital of the Upper Demerara-Berbice region, located at 6°0′0″N 58°18′0″W, altitude 48 meters (160 feet). It was declared as a town in 1970, and includes the communities of MacKenzie and Wismar. It lies on the Demerara River and has a population of roughly 29,298 (Census, 2002). There are regular deworming programs for children at school regulated by Ministry of Health through WHO and Pan American Health Organization. Various health regulated awareness programs are conducted sometimes on sanitation practices and provision of safe drinking water. But still, there are shortcoming in follow-up and continuous monitoring.

Questionnaires and intestinal helminths collection

This study was conducted during January-April, 2017. Phase one which included the distribution of questionnaires and the collection of stool samples was conducted during the 23rd to 29th of January 2017 in Silvercity, Linden. Members from thirty households with children aged 5-15 years were asked to complete a questionnaire in order to determine their level of awareness of the transmission of intestinal parasites and to collect the baseline data (Questions were on awareness of helminthiasis transmission, personal hygiene, sanitation and safe dirking water). Twenty-six children aged 5-15 years were then randomly for screening of intestinal helminths. Signed consent was received from each parent for the collection of samples. Each container was labeled with the age and gender of the child. Collected samples were preserved in 10% formalin and stored in a dry, cool place until they were ready to be transported to the University of Guyana laboratory for screening. Two methods were employed for the laboratory detection of intestinal helminths i.e. the formalin-ether sedimentation method and the fecal wet mount method. Both methods were done in triplicates to ensure accuracy and consistency.

The laboratory procedure of sample collection

The laboratory procedure for the formalin-ether sedimentation method as directed by the CDC (2013). The laboratory procedure is as follows: Stool samples were collected in sterile cups. An applicator stick was used to add 1 gram of the sample to 10 ml of formalin in a centrifuge tube and stirred to form a suspension. The suspension was then strained through two layers of wet surgical gauze into a different centrifuge tube and the gauze discarded. 10 ml of 10% formalin was added to the suspension to make it 20 mL**.** 3.0 mL of ethyl acetate was then added to the tube and be covered with a plastic cover and shaken vigorously for 10 sec. The tube was then placed in the centrifuge and centrifuged for 1000 x g for 2 minutes. The tube was then removed from the centrifuge and 4 layers were observed. The debris was gently loosened with an applicator stick and the top three layers were poured off by inverting the tube for 5 seconds. A drop of saline was then added to the fluid sediment using a pipette and mixed to form a suspension. A drop of the suspension was placed on a glass slide and gently spread into a thin film. A drop of iodine was then added to the thin film on the slide and heat fixed. The slide was left to cool for 5 minutes and after cooling, it was observed under the microscope using the 10x and 40x objective lens.

Data analysis

During observation, pictures were taken of helminths identified along with size recordings which were be used to identify them using lab manuals (CDS, 2013). Data was analyzed using the Fisher Exact test and Chi-square test (Microsoft Excel 2016).

RESULTS AND DISCUSSION

The results in the present research showed that 15 out of 26 children tested had intestinal helminthiasis. Male infections rates were slightly higher (n = 8) than females (n = 7) however Fisher Exact test (p=0.4527) revealed that there was no statistical significance (Table 1). The helminths identified using the identification keys (CDS, 2013) are presented in Table 2. These are fertilized, unfertilized eggs and larval stages. *Ascaris lumbricoides* accounted for 10 cases out of the total infections followed by *E. vermicularis* (5 cases), *Trichuris trichiura* (4 cases) and hookworm (1 case) which is statistically significant (p=0.0384). These are the most prevalent species in Guyana (Figure 3).

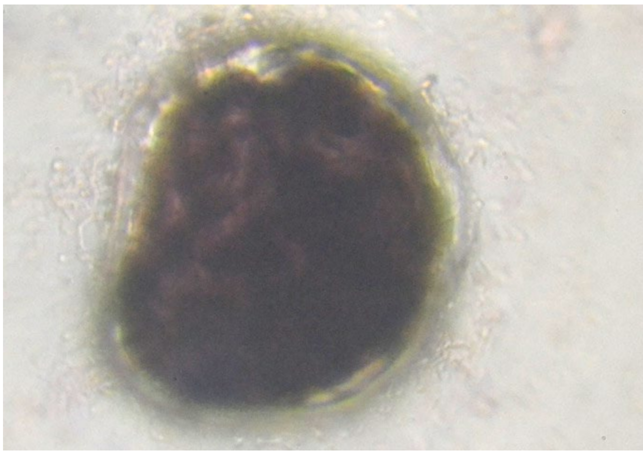
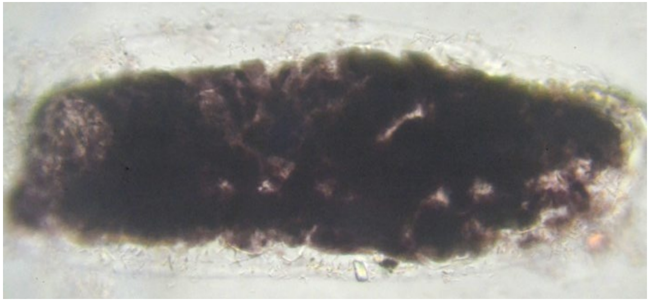
Table 1. Frequency of helminthiasis according to gender within the study area

Gender	Number infected
Male	8
Female	7
Total	15

Table 3. Distribution of double infections among males and females

Gender	Number infected with double infection
Male	3
Female	2
Total	5

Table 2. Helminths identified (key features)

Helminth type and distinguishing features	**Illustration**
Ascaris lumbricoides **Fertilized egg.** Thick round or ovoidal shell, yellow or brown. Mammillated albuminous coat on outer shell that may be lost. Decorticated eggs have colorless shell with grey or black internal material. 45-70 um x 35-75 um.	 (400x)
Unfertilized egg. Elongated. Maybe triangular, kidney-shaped or other forms. Brown; internal mass of irregular globules that fits shell. Mammillated covering often damaged or missing. 85-95x 35-45 um.	 (400x)
Trichuris trichiura Elongated, barrel-shaped with a polar plug at each end. Yellow or brown. 49-65 um x 20-29 um.	 (400x)
Enterobius vermicularis Smooth, thin shell that is elongated and asymmetrical with one side flattened another side convex. Colorless. 50-60 x20-32 um.	 (400x)
Hookworm: Rhabditiform larvae Inconspicuous genital primordium that is small and located near the pointed tail. Buccal cavity as long as width of body. 200-300 um x 14-17 um.	 (400x)

The gender distinction showed that frequency in male was slightly higher (n = 3) than females (n = 2) as seen in Table 3 and Figure 1, but Fisher Exact test revealed that there was no statistical significance (p=0.6348). It was also observed that 5 of the children tested had a double infection. The combination of *A. lumbricoides* and *E. vermicularis* was the most prevalent accounting with 3 cases. Other double parasitism included *A. lumbricoides* + *T. trichiura* and *T. trichiura*+ hookworm which was similar with 1 case for each (Figure 2).

The difference in the frequency among different age groups in the study population (Figure 3) which was found to be the statistically not significant (p=0.5981). Younger age group (5-7) had the highest prevalence (n = 8) followed by the 8-10 (n = 4) and 11-15 (n = 3). Questionnaire data revealed that only 40% (18 out of 30) of the community members interviewed were aware of intestinal helminthiasis.

This cross sectional study was the first of its kind to be conducted in the Silvercity area, Linden and the second to be conducted in Guyana to the knowledge of the researcher. The results showed that 15/26 (57.6%) of the children tested were infected with at least one helminths and 5/26 (19%) had double infections. This is similar to results obtained from a similar study conducted by Lindo et al. 2002. In this study, *A. lumbricoides* was found to be the most prevalent parasite. Despite the fact that male prevalence rates were slightly higher than females, there was no statistical significance. The same trend was observed for double infections. This was expected due to the likelihood of both males and females being engaged in the same activities and exposed to the same risk factors. Studies conducted by Lindo et al. (2002) and Wrights et al. (2013) produced similar results.

Statistical analysis showed that the prevalence of each of the different helminths across the study population is significantly different (p=0.0384). *A. lumbricoides* was the most prevalent followed by *E. vermicularis, T. trichiura* and hookworm the least. This could be because of poor sanitation practices including personal hygiene in spite of programmes conducted by Ministry of Health from time to time. Probably more thrust is required at awareness, implementation and follows up of various programmes. Intestinal worm infections especially soil-transmitted helminth affect two billion people worldwide in tropics and subtropics including Guyana. Main species are *A. lumbricoides*, *Trichuris trichiura,* and Hookworms. However maximum cases reported are due to Acariasis (Kumar et al. 2014). This result contrasts with a similar study conducted by Lindo et al. 2002 in which hookworm was the most prevalent species. This may be as a result of a difference in environmental conditions. It has also been observed by Bethony et al. 2002, that hookworm infections are more prevalent in adults than in children. This may also explain why the prevalence in this study was so low. The prevalence of *E. vermicularis* found in this study cannot be accurately stated because only a small portion of patients stool shows the presence of eggs in the stool (Arora and Arora 2014).

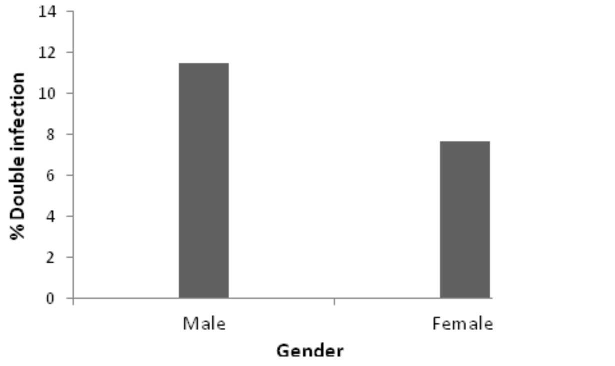


Figure 1. Distribution of double infections among genders (n=26)

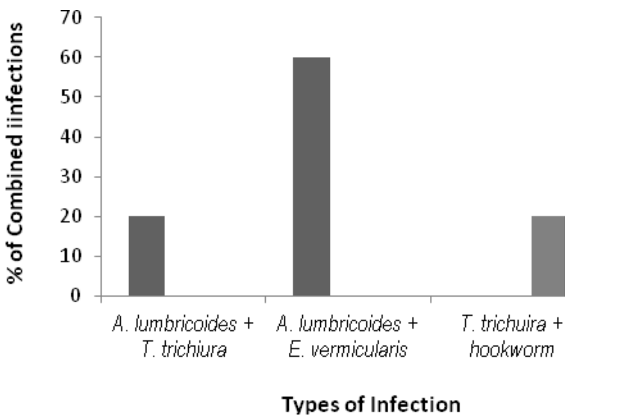


Figure 2. Double infections found in children within the study area (n=26)

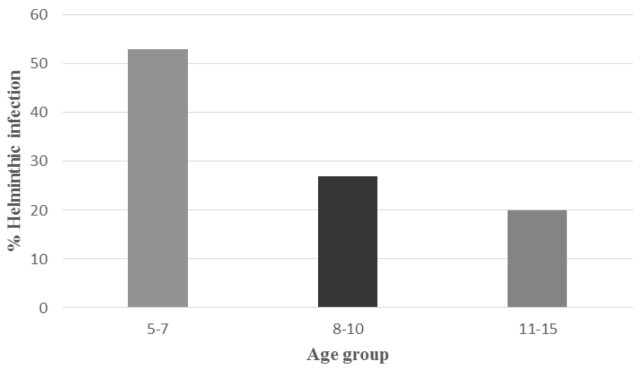


Figure 3. Prevalence of helminthic infection by age within the study area (n=26)

Statistical analysis also revealed that there is an age dependent relationship as prevalence decreased as age increased. It was found that greater prevalence was found in the youngest age group and prevalence gradually decreased as age increased. A similar relationship was also found by Anuar et al. (2014). This is supported by earlier studies that young children are vulnerable to helminth infections as they can harbor heavy infections due to smaller body size and are less able to handle the worm burden. They are also exposed to higher risk factors of anemia and malnutrition. The conditions in tropical climate with warm and moist climate with added pressure of cluster sanitation and health hygiene practices compound the problems further (Lindo et al. 2002).

Questionnaire data showed that only 40% of community members in this study were aware of the transmission of intestinal helminths. Mascarini-Serra (2011) found that a low rate of awareness coupled with lack of healthcare and diagnostic facilities makes those in poor communities more susceptible to disease and illnesses caused by helminth infections. In conclusion, from the above study, it can be concluded that majority of intestinal infections are carried out with the help of *A. lumbricoides* than *E. vermicularis*, *T. trichiura*. Though various types of experiments are followed in this regard but still it cannot judge that the affected people have enough awareness about the helminthic infections. Poor level of awareness sometimes fails to get attention about the preventive measures of helminthic infections. This study highlighted the fact the intestinal parasitic helminths are present in children of the Silvercity community and the knowledge of transmission is low which may be a contributing factor to infection. It is essential for young children to be in optimal health so as facilitate the development of healthy bodies and minds. Therefore it is necessary to combat these infections through the combined efforts of government and the community by increasing education, improving sanitation and regular de-worming

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