JIRCMS Vol.: 04 II Issue 01 II Pages 01-05 II March 2020

Physicochemical Determination and Occurrence of Soil Transmitted Helminths in the Garden Soil of a Secondary School Intanza, Cavite, Philippines

Genevee M. Banta, MD[1], Mildred M. Capiña[2]

[1] College of Medicine, De La Salle Medical and Health Sciences Institute, Gov.D. Mangubat Ave.,Dasmariñas City, Cavite

[2] Senior High School, Science Department, Tanza National Trade School, Paradahan 1, Tanza, Cavite

1geneveebanta@gmail.com 2mildredmcapina@yahoo.com

Abstract: Soils play a major role in the distribution and prevalence of STH, it can be contaminated with large number of helminth eggs, which commonly infect people through oral ingestion. According to Global Atlas of Helminth Infection (2017), the STH infection is the largest contributor to the disease burden of neglected tropical diseases. Studies conducted all over the world show variable prevalence of soil contamination with different parasite genera. There is still no epidemiological data of any soil contamination in the chosen school for this study, hence, there is a need to survey the garden soil for the presence of parasites. Soil samples were collected from the four quadrants of the garden soil of a secondary school in Tanza, Cavite, Philippines. Using floatation technique with zinc sulfate, four helminths species were identified - *Taenia spp., Ascaris spp., Dipylidium spp*., *Taenia spp.* and *Trichuris spp*. The recorded soil temperature and soil pH were 23.8 °C to 24.2 °C and 7.09 to 7.54, respectively and these ranges allow the survival and development of the identified STH eggs. The occurrence of STH eggs in the garden soil can be a continual source of STHs infection to the students of the secondary school in Tanza, Cavite, Philippines. Therefore, safety practices in gardening should be strictly implemented and also school policies regarding protection of students against STH should be developed.

Keywords: floatation technique, neglected tropical diseases, soil-transmitted helminths

Introduction

Soil-transmitted helminthic infection is an illness that is commonly caused by accidental ingestion of parasitic eggs. South Asia, Southeast Asia, and Sub-Saharan Africa are the regions with the highest prevalence of species of soil-transmitted helminths (STH) also known as geohelminths (Pullan et al., 2014). Common STH causing infection in man in tropics and subtropics are roundworm (*Ascaris lumbricoides*), hookworm (*Ancylostoma duodenale* and *Necator americanus*), and whipworm (*Trichuris trichiura*) (Kafle et al., 2017). It is estimated that over 1.5 billion of people are infected with at least one species of these STH (WHO, 2015).

The STH infection is the largest contributor to the disease burden of neglected tropical diseases and have been recognized as an important public health problem (Global Atlas of Helminth Infection, 2017). As the name implies, soils play a major role in the distribution and prevalence of STH since it is one of the main reservoirs of helminth eggs particularly in areas with poor environmental sanitation. Soils can be contaminated with large number of helminth eggs, which subsequently infect people through oral ingestion or direct skin contact, thus, any suitable conditions for the survival of the parasite can cause serious problems. (Ziegelbauer et al., 2012). Soil is the main resource for human infection and can be a direct indicator for the risk of infection among human populations, especially children. The contamination of the school garden soil can also cause significant health problems to the students. Children have the highest prevalence and intensities of infections and are particularly vulnerable to STH infections which reduce physical and cognitive development and contribute to anemia (Yawson et al., 2018). School aged children commonly acquire soil-transmitted helminthic infection probably because they practice poor hand hygiene and they enjoy playing with contaminated toys or materials. Due to this, they are at risk for soil-transmitted helminthic infection.

Studies conducted in various cities all over the world show variable prevalence of soil contamination with different parasite genera. There is still no epidemiological data of any soil contamination in the chosen school for this study. In the light of that, there is a need to survey the garden soil for the presence of parasites. This study mainly aims to determine the physicochemical characteristics of the garden soil and also to determine STH eggs in the garden soil of a secondary school in Tanza, Cavite, Philippines. This can be a basis for having preventive measures to avoid the impact of the disease on children. The study will be beneficial to the students and also to their parents

because it will inform them of the possible risk of the students in getting soil-transmitted helminthic infections and will also encourage them to practice proper hygiene. The study will also inform the school regarding the need of proper education about parasitic infection and also its prevention. Moreover, it will also encourage the school to make necessary precaution and also a plan for the soil treatment if there is any significant finding in the study.

Methodology - *Research design*

This is a descriptive study which determined the occurrence of soil-transmitted helminths. The physicochemical characteristics of the soil such as the pH and temperature were determined and STH egg were identified using floatation method with zinc sulfate.

Study Area

This study will be carried out in the garden, also known as "Gulayan sa Paaralan", of a secondary school in Tanza, Cavite, Philippines. Every school calendar, the "Gulayan sa Paaralan" is usually planted with seasonal vegetables like tomatoes, eggplant, long beans, cucumber, okra, squash and taro.

Sample Collection

The Gulayan sa Paaralan, measures 150 x 200 meters, is subdivided into four quadrants (Figure 1). Soil samples were collected from each quadrant. Approximately 200 grams of soil were obtained from an approximate depth of 3cm, and all samples were placed in properly labelled plastic containers.

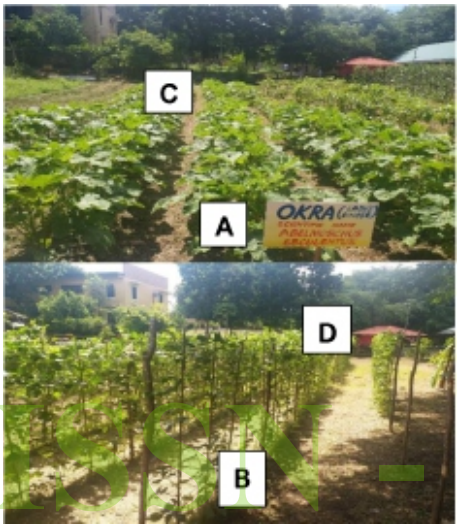

Plate 1. Location of the four quadrants in the "Gulayan sa paaralan"

Floatation technique using zinc sulfate

The modified procedure of Yawson et al. (2018) was the basis of the floatation technique using zinc sulfate. Initially, four beakers were prepared and properly labeled. Each of the beakers were poured with 1 liter distilled water, then, 30 grams of soil samples from each of the quadrants were added and mixed with the distilled water. The physicochemical characteristics, temperature and pH of the soil-water mixtures, were recorded. The soil-distilled water mixtures were allowed to stand for 1 hour. Then, 5ml decantate is transferred to a properly labeled test tube and zinc sulfate is added until the tube is full. The cover slip was placed on top of the test tube for 15 minutes. Then, the cover slip was placed on a glass slide for observation under a light microscope using x40 objective lenses.

RESULTS AND DISCUSSION - Results

Environmental factors such as pH and temperature were recorded from each quadrant (Table 1). The soil pH ranges from 7.09 to 7.54 while soil temperature ranges from 23.8 °C to 24.2 °C. The recorded physico-chemical parameters of the soil samples have near values.

Table 1. Physicochemical characteristics of soil samples from the garden soil of a secondary school in Tanza, Cavite, Philippines

Environmental parameter	Quadrants			
	A	B	C	D
pH	7.54	7.13	7.09	7.12
Temperature (°C)	23.8	24.2	24.2	24.1

The soil samples obtained from the garden soil of a secondary school in Tanza, Cavite, Philippines are positive for the occurrence of STH (Table 2). The STH eggs detected were *Ascaris spp, Dipylidium spp, Taenia spp* and *Trichuris spp.*

Table 2. Identified STHs eggs using floatation techniques with zinc sulfate

STHs egg	Floatation technique using zinc sulfate
Ascaris spp	+
Dipylidium spp	+
Taenia spp	+
Trichuris spp	+

Discussion:

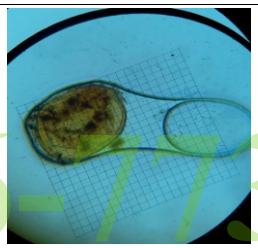

Plate 2: Microscopic slide of *Ascaris spp.* ova with its morphological features.

Ascaris spp are parasitic nematode (Family Ascarididae) infections of humans infecting 1.2 billion people globally (de Silva et al., 2003).The spectrum of disease associated with *Ascaris spp.* infection is known as ascariasis that results to impaired childhood nutrition, surgical complications and

allergic reactions, and morbidity assessed as disability-adjusted life years is approximately 10.5 million (Chan, 1997).

Plate 3: Microscopic slide of *Dipylidium spp.* ova with its morphological features.

Dipylidium spp. are trematodes that are common tapeworms of cats and dogs. These parasites have indirect life cycle with cats, dogs and also humans as the definitive hosts while the fleas are the vectors. It can cause anal itchiness in animals but in humans, its infection may be asymptomatic (John et al., 2010).

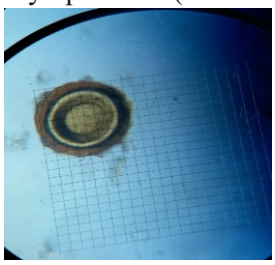

Plate 4: Microscopic slide of *Taenia spp.* with its morphological features.

Taenia spp. are long, segmented, parasitic tapeworms (family Taeniidae, subclass Cestoda). These parasites have an indirect life cycle, cycling between a definitive and an intermediate host. *Taenia spp* is known to cause taeniasis, cysticercosis, neurocysticercosis, coenurosis, neurocoenurosis (Iowa State University, 2005).

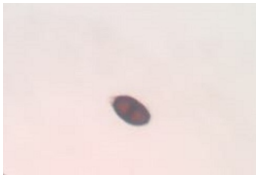

Plate 5: Microscopic slide of *Trichuris spp.* ova with its morphological features.

Trichuris spp. are nematode parasites in the family Trichuridae. These parasites are also known as whipworms and have a direct life cycle, and mature in a single host. The host becomes infected when it ingests embryonated eggs from the environment and causes trichuriasis (Iowa State University, 2005). According to Mohaghegh et al., (2017), human infections with this parasite are associated with some clinical disorders, which are similar to that of inflammatory bowel disease, such as chronic abdominal pain, diarrhea and other disorders such as impaired growth, anemia and finger clubbing.

Soil provides appropriate conditions for conversion of STHs eggs to the infective stage, also, presence of eggs in the superficial layers of the soil is one of the factors affecting their transition within the humans (Hotez, 2008). This study did not investigate the possible source of STHs but according to Gazzinelli et al., (2012) soil pollution with fecal materials is instrumental in the transmission of STH infection. Fertilized eggs deposited in the soil develop rapidly and, depending on environmental conditions, may reach the infective stage within a matter of weeks. Thereafter, eggs are transferred from soil to the vegetables then onto to hands and finally to the mouth. In this study, the STH eggs are detected and also identified in the garden soil of a secondary school in Tanza, Cavite, Philippines. Due to this, the students have high chances of getting infected during gardening. Aside from the soil, the students may also be exposed to the parasites thru the contaminated vegetables and other plants.

Development of STH eggs in the outside environment, particularly in soil, is affected by several factors such as temperature, humidity, pH, depth, and soil texture. These might affect their development by hastening their embryonation, viability, infectivity, and size (WHO, 2004; Amadi and Uttah 2010). According to Larsen and Roepstorff (1999) and Geenen et al., (1999), the embryogenesis of helminth eggs depending on the ambient temperature can be measured to predict prevalence of soil-transmitted helminths and it is known that the egg development and survival are affected by temperature. Study of Kim et al., (2012) showed that at 5°C, the helminths eggs did not develop over one month but there is induced egg development at 25°C and 35°C after 6-8 days of incubation. Lesikar et al., (2005) identified that the optimum temperature for the embryonation of STH eggs ranges from 21°C to 28°C. World Health Organization (2004) mentioned that the response of STH eggs may vary depending on the temperature. *Ascaris spp* can adapt with the changing environment and can even withstand low temperature up to -9°C than *Trichuris spp.* On the other hand, *Taenia spp.* cannot tolerate high temperature as high as 71°C and may even die within 5 minutes. In this study, the soil temperature ranges from 23.8-24.2°C which is just suitable for the viability and survival of the identified STH eggs.

Optimum pH promotes the hatching of the eggs and also contribute in providing the necessary nutrients and electrolytes. Helminths can tolerate pH range of 4.6–9.4 and will still be able to hatch and infect (WHO, 2004). Alkalinic environment promotes the development of *Ascaris'* eggs but its normal

development is interrupted if the environment becomes acidic. Meanwhile, there is destruction of the *Taenia* eggs at pH 12. Hence, extreme pH also has deleterious effect on the STH eggs. The soil samples in this study has a pH of 7.09-7.54 which is also appropriate for the viability of the identified STH eggs.

The Department of Education implemented the Deped Memoranda 095, Series of 2018- Gulayan sa Paaralan program in public elementary and secondary schools nationwide which primarily aims to address undernutrition and short-term hunger among public school children, hence, improving their nutritional status. However, despite nutritional benefits, vegetables and fruits serve as vehicles for human disease causing agents (FAO 2010; WHO 2012); and studies showed that many vegetables and fruits sold in the markets were contaminated by soil transmitted helminths, STHs (Uneke and Udegbunam, 2015; Abe et al., 2016). In the Gulayan sa Paaralan in a secondary school, STH eggs such as *Ascaris spp, Dipylidium spp, Taenia spp* and *Trichuris spp* were detected. Hence, it is important to take necessary precaution when handling the soil and also the plants. Reduced amount of helminth eggs in the soil may be due to exposure to ultraviolet light for a prolonged period of time, washed off by rain or flow of water and even during harvesting (Yawson et al., 2018). In relation to this study, only four helminthic species were identified. It is possible that the other STH eggs has been washed off since the soil was collected during a rainy season.

CONCLUSION

This preliminary study identified four STHs species namely *Ascaris, Dipylidium, Taenia* and *Trichuris spp.* in the garden soil of a secondary school in Tanza, Cavite, Philippines with floatation technique using zinc sulphate. The recorded temperature and pH of soil samples provide tolerable environment for the development of STHs eggs. The garden soil is a continual source of parasitic infection in children during gardening.

Acknowledgement

The authors would like to thank Dr. Cristina C. Salibay for sharing her expertise in Parasitology and Mr. Darylle Cesar G. Hilapo for sharing his knowledge in experimental research.

References

Abe, E.M., Ajah, L.J., Ayuba, S.O., Mogaji, H. and Ekpo, U.F. 2016. Geohelminths Contamination of Fruits and Vegetables sold in Lafia Markets. Annual Research & Review in Biology, 11(2):1-8.

Amadi E, Uttah E. 2010. "Impact of physico-chemical factors of contaminated foci on the survival of geohelminths in Abua Communities, Niger Delta Nigeria," Journal of Applied Science and Environmental Management, vol. 14, no. 4, pp. 117–121.

Azian M, Saknone L, Hakim S, Yusim M, Nurulsyamyawaty Y, Zukaizam A, Rodi I and Maslawaty M. 2008. Detection of helminth infection in dogs and soil contamination in rural and urban areas. Southeast Asian J Trop Med Public health; 39(2)

Chan MS. 1997. The global burden of intestinal nematode infections—fifty years on, Parasitol. Today 13; 438-443.

de Silva NR, Brooker S, Hotez PJ, Montresor A, Engels D, Savioli L. 2003. Soiltransmitted helminth infections: updating the global picture, Trends Parasitol. 19; 547- 551.

FAO (2010). Growing Green Cities: Food and nutrition security.www.fao.org.

Gazzinelli A, Correa-Oliveira R, Yang GJ, Boatin BA, Kloos H. 2012. A research agenda for helminth diseases of humans: social ecology, environmental determinants, and health systems. PLoS Negl Trop Dis.;6(4)

Geenen PL, Bresciani J, Boes J, Pedersen A, Eriksen L, Fagerholm HP, Nansen P. 1999. The morphogenesis of *Ascaris suum* to the infective third-stage larvae within the egg. J Parasitol.; 85:616–622.

Global Atlas of Helminth Infection. 2017. Global burden. London Applied and Spatial Epidemiology Research Group (LASER), London School of Hygiene and Tropical Medicine

Hotez PJ, Brindley PJ, Bethony JM, King CH, Pearce EJ, Jacobson J. 2008. Helminth infections: the great neglected tropical diseases. J Clin Invest.;118(4):1311–21.

John D and Petri W. 2010. Markell and Voge's medical parasitology.9th ed. Singapore: Elsevier; 2010. p.232-233.

Kafle CM, Ghimire S, Dhakal P, Shrestha U, Poudel S, KC R, Adhikari N, Tuladhar R. 2014. Identification of Parasites in Soil Samples of Vegetable Field of Bhaktapur District. TUJM 2(1); 26-28

Kim MK, Pyo KH, Hwang YS, Park KH, Hwang IG, Chai JY, Shin, E.H. 2012. Effect of temperature on embryonation of Ascaris suum eggs in an environmental chamber. *The Korean journal of parasitology*, *50*(3), 239– 242. doi:10.3347/kjp.2012.50.3.239

Larsen MN, Roepstorff A. 1999. Seasonal variation in development and survival of *Ascaris suum* and *Trichuris suis* eggs on pastures. Parasitology;119:209–220.

Lesikar B, Hallmark C, Melton R, Harris B 2005. On-Site Wastewater Treatment Systems: Soil Particle Analysis Procedure, Agri Life Extension, Texas A and M Systems..

Pullan RL, Smith JL, Jasrasaria R, Brooker SJ. 2014. Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. Parasit Vectors. Parasites & Vectors; 7: 37

Uneke, B.I and Udegbunam, R.O. 2015. Geohelminth Contamination of Common Fruits and Vegetables

in Ebonyi State, Nigeria: The Public Health Implication. American Association for Science and Technology. Journal of Bioscience, 1(2): 15-19.
WHO, World Health Organization. 2015. Investing to overcome the global impact of neglected tropical diseases: Third WHO report on neglected tropical diseases. WHO Document Production Services, Geneva, Switzerland
WHO. 2004. Integrated guide to sanitary parasitology. Regional office for the Eastern Mediterranean: Regional centre for environmental health activities. Jordan
WHO. 2004. WHO Model Formulary. Based on the 13th Model List of Essential Medicines 2003. Geneva: WHO, pp. 82–85.
Yawson DO ,Kudu IB ,Adu MA. 2018. Soil-Transmitted Helminths in Top Soils Used for Horticultural Purposes in Cape Coast, Ghana. Journal of Environment and Public Health; 2018:1-5
Ziegelbauer K, Speich B, M¨ausezahl D, Bos R, Keiser J, Utzinger J. 2012. Effect of sanitation on soil-transmitted helminth infection: systematic review and meta-analysis. PLoSMedicine; 9(1); 1-6