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Original Article

Domesticaed Cats as a Source of Environmental Contamination with Toxocara cati and Other Soil-Transmitted Helmminth Eggs in Urban Area, Manila Philiphines

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ABSTRACT

Toxocariasis and soil-transmitted helminthiases are the most prevalent parasitic zoonoses affecting humans and animals that cause environmental contamination. *Toxocara* and other soil-transmitted helminth eggs in animal feces are the primary sources of soil-transmitted helminthiases transmission in the environment particularly in urban areas. These parasite eggs constitute a source of infection for both definitive and paratenic hosts. Avian and rodents, that can be paratenic hosts of these parasites, are a significant source of food for cats in urban settings. Stray cats and dogs also consume leftover food or receive frequent feedings from locals that increases the chance of acquiring soil-transmitted helminth infections. Despite the risks that these soil-transmitted helminths have, studies and information regarding their zoonotic potential is very limited to date. This study aimed to determine the relationship between cat feces and the environmental contamination of residential soils with *Toxocara cati* and other soil-transmitted helminth eggs. This study is cross-sectional design, using total of 50 samples were collected in selected urban residences in Malate, Manila. Stool samples were processed using Formol-Ether Concentration Technique while optimized sugar flotation technique was used for the soil samples then both were subjected to microscopy. The overall infection rate was 76% and the contamination rate was 52%. *Toxocara cati* was the most prevalent zoonotic parasite identified in 48% of stool and 44% of soil samples followed by *Ascaris* spp. with 32% in stools and 16% in soil samples. *Trichuris* spp. with 24% and hookworm with 16% were also detected in stool samples but were absent in soil samples. The presence of *Toxocara cati* and *Ascaris* spp. eggs in feces and their environmental contamination might be accounted to their durable and highly resistant eggs as well as the as the Philippines as a tropical country which may induce optimal conditions for *Toxocara* spp. and other soil-transmitted helminth eggs' development and survival.

Keywords: cats; soil; zoonosis; public health; prevalence; *Toxocara* spp.

INTRODUCTION

Toxocariasis is a zoonotic parasitic disease that is endemic across the globe particularly in China, India, Mexico, United States, and the Philippines. This parasitic disease is caused by nematodes of cats and dogs, *Toxocara cati* and *Toxocara canis*, respectively.[1] *Toxocara* spp. are abundant intestinal parasites inhabiting in the intestines of cats and dogs, particularly in kittens and puppies which are most susceptible to these parasitic infections. The zoonotic potential that these parasites carry provides disease burden and public health concern. High prevalence rates were recorded in vulnerable poor communities of tropical and sub-tropical regions where these animals freely roam, are living with human population, and are not dewormed.[2] Climate, socioeconomic, and other ecological factors all have a

considerable impact on the prevalence rate of *Toxocara* spp. infections.[3]

Human toxocariasis is one of the top five neglected parasitic diseases according to the American Centers for Disease Control and Prevention (CDC). Accidental ingestion of *Toxocara* eggs from the contaminated environment, specifically in soils, is the primary mode of transmission for human toxocariasis.[4] Consuming larvae that are dormant in the tissues of paratenic hosts is another method of transmission for these intestinal parasites. Not only are eggs on the soil associated to direct human infection, but they may also be a source of contamination for pets' coats. Recent studies have discovered the presence of infectious eggs on the coats of pets, indicating that close contact with these animals may pose a high risk to people. It is noteworthy that the presence of embryonated *Toxocara* eggs on the fur of animals has been identified as a source of infection in humans through hand-to-mouth contact.[5]

In urban and rural regions in the Philippines, public areas such as streets, parks, and playgrounds are accessible to stray and domesticated felines like cats. Public sands and soils in these areas are the usual spots for their open defecation practices which are mainly responsible for soil contamination with *Toxocara* spp. eggs. Both stray and domesticated pet animals pose hazard to exposed individuals, although the latter is thought to pose a greater risk of human infection because of their frequent contact with people.[6] However, despite these recent findings, the role of cats in transmission of zoonotic parasites is neglected and not fully understood. The aim of this study is to determine the relationship between cat feces and the contamination of residential soils with *Toxocara cati* and other soil-transmitted helminth eggs.

METHODS

2.1 Collection of Stool Samples

A total of 50 samples, 25 stools and 25 soils, were collected from domesticated cats and gardens in residences of Malate, Manila (14°33'54"N 120°59'26"E) in May 2022. All cat feces and soil samples were collected simultaneously. In each residence, approximately 250g of soil sample was collected using a shovel at the depth of 10 cm. Collected stool and soil samples were immediately placed in pre-labeled stool cups with 10% formalin and sealed-labeled Ziplock locks, respectively. These samples were transported to De La Salle University Science and Technology Research Center (STRC) Zoology and Parasitology Laboratory for coproparasitological assessment

2.2 Formol-Ether Concentration Technique (FECT)

In about 1g of cat feces, the Formol-Ether Concentration Technique (FECT) was utilized to detect the presence of *Toxocara cati* and other soil-transmitted helminth eggs. The identification of *Toxocara cati* and other soil-transmitted helminth eggs were based on the morphological criteria observed during microscopy in reference to Bench Aid by WHO.[7]

2.3 Optimized Sugar Floatation Technique

Soil samples were air dried for 24 hours upon arrival at the STRC laboratory before sifting with a mesh of 150 micrometers to separate and filter trash, small pebbles, and other coarser debris that might impede the recovery and detection of parasite eggs. Soil samples were examined using the optimized sugar flotation method by Horiuchi *et al.* in 2016.[8] Under a standard light microscope, *Toxocara cati* eggs were detected and identified based on morphological characteristics.

2.4 Statistical Analysis

The prevalence rates of *Toxocara cati* and other soil-transmitted helminths in domestic cats and its environmental

contamination were calculated using non-parametric statistical analysis.

2.5 Quality Assurance Assessment

Quality assurance criteria, such as adequate sample collection, the use of pertinent materials, and the execution of acceptable laboratory procedures, are used to ensure the validity and consistency of the parasitic screening. To avoid errors and assure data precision, a parasitologist aided and double-checked the identification of *Toxocara cati* and other soil-transmitted helminth eggs.

2.6 Ethical Considerations

Prior to starting the study, consent from locals who owned the residences with domestic cats was obtained. Pet owners were also informed of the procedures to be carried out and asked for their consent. All animal testing conducted for this study complied with the ethical standards established by De La Salle University Research Ethics Office (REO) for the use of animal material.

RESULTS

In total, 76% (19 out of 25) of the cat stool samples and 52% (13 out of 25) of the soil samples were positive for soil-transmitted helminth eggs. Of these, *Toxocara cati* was the most prevalent soil-transmitted helminth with 48% (12 out of 25) in stool samples and 40% (10 out of 25%) in soil samples. It was followed by *Ascaris* spp. with 32% (8 out of 25) in stool samples and 16% (4 out of 25) in soil samples. Other soil-transmitted helminths such as *Trichuris* spp. with 24% (6 out of 25) and hookworm with 16% (4 out of 25) were also detected in stool samples but were not found in soil samples (Table 1).

Despite the limited number of stool and soil samples analyzed, a diversity of zoonotic parasites were identified suggestive of high prevalence of infection and environmental contamination. Felines and canines, primarily cats and dogs, are the primary source of *Toxocara* spp. and other soil-transmitted helminth infections. Although, it has been reported in a wide range of mammalian animals, including humans.

Table 1. Prevalence of *Toxocara cati* spp. eggs in cat fecal and soil samples in private residences of Malate, Manila

Soil transmitted helminths detected	Prevalence of infection among cats		Contaminated soils with STH eggs	
	n=25	%	n=25	%
Toxocara cati	12	48	11	44
Ascaris spp.	8	32	4	16
Trichuris spp.	6	24	0	0
hookworm	4	16	0	0

DISCUSSION

The prevalence of *Ascaris* spp. eggs in soil samples was 16%, which was lower than the percentage of *Toxocara* spp. eggs with 44%. The results of this study, in which *Toxocara* spp. eggs were found at a significantly higher prevalence rate in cat feces concur with the findings of Mizgajska-Wiktor *et al.* (2018).[9] The accidental infection with non-feline soil-transmitted helminth eggs such as *Ascaris* spp. in the feces of cats suggests that exposure with a contaminated environment is crucial in the animals' acquisition of eggs and potential infection.[10] However, despite that cats are assumed to be the primary source of *Toxocara* spp. and soil-transmitted helminth egg contamination, their involvement in transmission is not thoroughly recognized or documented. To date, there have been few investigations on the involvement of domesticated cats in the transmission of parasitic diseases.

Soils have an important role in the transmission of *Toxocara* spp. and other soil-transmitted helminths to humans, particularly school-age children.[11] The presence of infective eggs or larvae in the environment is critical in the several routes of cat soil-transmitted helminth transmission in both animals and humans. *Toxocara* spp. most commonly infects humans by coming into contact with contaminated soil.[12] *Toxocara* spp. and other soil-transmitted helminths infect humans by ingesting embryonated eggs obtained from contaminated soils. Other means of transmission include accidental ingestion of larvae residing in paratenic hosts' tissues, or even penetration into the skin in the case of hookworm larvae in contaminated soil. Hookworms can penetrate the human skin when they touch or walk barefoot on contaminated soils.[13]

Nematodes such as *Toxocara cati* can induce a variety of clinical manifestations in humans, including visceral larva migrans syndrome, ocular larva migrans syndrome, neural larva migrans syndrome, and covert toxocariasis.[14] Zoonotic hookworms can cause a variety of gastrointestinal, dermatological, and pulmonary conditions with the most common being cutaneous larva migrans. High prevalence and intensity of soil-transmitted helminth infection were predominantly recorded among school-age children, less than the age of twenty, due to their play habits in outdoor environments which prolong their exposure to potentially infected animals and contaminated environments.[15] The number of cats and their feces, the long-term deposition of eggs, and the infectivity status of their feces, all contribute to the contamination of soils with *Toxocara* spp. and other soil-transmitted helminths. This phenomenon may well be characterized by cats' tendency to defecate in sand and soils. The abundance of cat feces in the residences elevated the risk of contamination of the environment and infections for humans living with their pets.

Despite that parasite eggs may be found in many urban and commercial places, the concern of environmental contamination is especially important in areas with limited resources due to significant parasite control initiatives are financially limited. Additionally, in these impoverished areas, there is a lack of understanding of health implications among the populace, a lot of stray and feral animals, and a weak public health system which hamper the elimination of these parasitic zoonoses. The role of domesticated animals, such as cats in urban settings, is an external factor leading to environmental contamination with soil-transmitted helminths. The practice of pet owners not collecting their pet's feces from public places is an issue for the sanitation and hygiene of both humans and animals. As a result, contaminated public spaces present a significant hazard to public health from zoonotic soil-transmitted helminths of animals such as cats. To avoid these potential zoonotic disease hazards, pet owners must be educated about the risks of this close relationship and informed as to how to safeguard themselves and their pets.

Given the lack of effective strategies for reducing environmental egg contamination, preventing early contamination is the most significant solution to prevent human and animal parasitic diseases. Aside from social responsibility in removing cat feces from public areas, proper helminth control programs, particularly in young kittens, are critical to controlling fecal contamination and reducing the risk of infection for people and other animals. Reduced contamination of public spaces by cat and other animal helminths can only be addressed by a variety of strategies, such as efficient helminth control programs, veterinary education, and pet owner and public conduct. To minimize the risk of a public hazard, the link between public health experts, veterinarians, doctors, and every member of the community ought to be enhanced in the direction of the One Health Approach. This approach must stimulate interest and efforts in suitable control, prevention, and treatment

initiatives aimed at reducing urban contamination and the risk of infection for both humans and animals with the aid of the collaborative efforts of different disciplines to accomplish optimal health of animals, humans, and the environment. Individualized animal care and rehabilitation treatment is also required to manage these parasitic diseases in pets as well as the potential environmental contamination. Moreover, regular surveillance and deworming of pets with the assistance of veterinary health professionals, proper hygiene and sanitation practices, controlled population of pets, and proper environmental hygiene are necessary to prevent the spread of these zoonotic parasitic diseases.

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REFERENCES

1. Hotez PJ, Wilkins PP. Toxocariasis: America's most common neglected infection of poverty and a helminthiasis of global importance?, *PLoS Negl Trop Dis*, 2009;3e400
2. Macphersom CNL. The epidemiology and public health importance of toxocariasis: A zoonosis of global importance. *Int. J. Parasito*l. 2013, 43, 999-1008, doi: 10.1016/j.ijpara.2013.07.004.
3. World Health Organization (WHO). Soil-transmitted helminth infections. *WHO*. Available: https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections. Accessed: 2 March 2020
4. Traversa, D., Frangipane di Regalbono, A., Di Cesare, A. et al. Environmental contamination by canine geohelminths. Parasites Vectors 2014; 7, 67. https://doi.org/10.1186/1756-3305-7-67
5. Deplazes P, van Knapen F, Schweiger A, Overgaauw PA. Role of pet dogs and cats in the transmission of helminthic zoonoses in Europe, with a focus on echinococcosis and toxocarosis. *Vet Parasitol*. 2011, 182 (1): 41-53. 10.1016/j.vetpar.2011.07.014.
6. El-Tras WF, Holt HR, Tayel AA. Risk of *Toxocara canis* eggs in stray and domestic dog hair in Egypt. *Vet Parasitol.* 2011, 178 (3–4): 319-323.
7. World Health Organization (WHO). Bench aid for the Diagnosis of Intestinal Parasites-Second edition. *Department of Neglected Tropical Diseases.* May 2019. ISBN: 978 92 4 151534 4
8. Horiuchi S and Uga S. Modified floatation method, an effective technique for recovering helminth eggs in soil. *Parasitol Int,* 65 (5) (2016), pp. 576-579
9. Mizgajska-Wiktor H., Jarosz W., Fogt-Wyrwas R., Drzewiecka A. Distribution and dynamics of soil contamination with *Toxocara canis* and *Toxocara cati* eggs in Poland and prevention measures proposed after 20 years of study. *Vet. Parasitol*. 2017, 234, 1-9, doi: 10.1016/j.vetpar.2016.12.011.
10. Holland CV, Smith HV (2006). *Toxocara*: The Enigmatic Parasite. Wallingford, *UK: CABI Publishing;* 2006.
11. Manini MP., Marchioro AA., Colli CM., Nishi L., Falavigna-Guilherme AL. Association between contamination of public squares and seropositivity for *Toxocara* spp. in children. *Vet. Parsitol*. 2012, 188, 48-52, doi: 10.1016/ j.vetpar.2012.03.011.
12. Fisher M. (2003). *Toxocara cati*: an underestimated zoonotic agent. *Trends Parasitol* 2003, 19(4):167–170.
13. Morgan ER, Azam D, Pegler K. Quantifying sources of environmental contamination with *Toxocara* spp. eggs. *Vet Parasitol* 2013, 193(4):390–397.
14. Overgaauw PAM, Van Knapen F. Dogs and nematodes zoonoses. In Dogs Zoonoses and Public Health. 1st edition. Edited by MacPhersom CNL, Melsin FX, Wandeler A. *New York: CABI Publishing Oxon*; 2000:213–245.
15. Despommier D. Toxocariasis: clinical aspects, epidemiology, medical ecology, and molecular aspects. *Clin Microbiol Rev* 2003, 16(2):265–272.