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RESEARCH

STRAY ANIMALS (DOGS AND CATS) AS SOURCES OF SOIL-TRANSMITTED PARASITE EGGS/CYSTS IN TEMPLE GROUNDS OF BANGKOK METROPOLITAN, THAILAND

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ABSTRACT

Soil contaminated with helminth eggs, larvae and protozoan cysts is a potential source of infection and poses a threat to the public, especially to young children spending their time on the playgrounds. The present study determines the prevalence of soil-transmitted parasite eggs/cysts in soil samples from temple grounds in 50 districts of Bangkok Metropolitan, Thailand. Nine hundred and fifty soil samples from 95 temple grounds (10 samples per temple) were examined for infection intensity using egg/cyst counts per 50 gram of soil sample using the double centrifugal flotation technique. Soil samples from 42 districts (84.0%) were found to be contaminated with eggs from eight nematode genera, two nematode larvae and coccidian cysts. The highest prevalence for parasite eggs was *Toxocara* eggs (64.0%) followed by *Ancylostoma* eggs (36.0%) and *Spirocerca* eggs (30.0%). The presence of *Toxocara*, *Ancylostoma* and *Trichuris* eggs in soil samples highlights the risk of transmission to the human population, especially monks, nuns and children who live nearby the temple.

Keywords: soil-transmitted parasite, dogs, cats, zoonoses, temple, Bangkok, Thailand

INTRODUCTION

Soil is an important source for transmission of various human and animal pathogens including soil-transmitted parasites, such as roundworm, hookworm, whipworm and threadworm. Almost 900 million people were infected with roundworm and more than 400 million were infected with hookworm and whipworm (Pullen et al., 2014; Collender et al., 2015). Stray dogs and cats had been traditionally left at the temples based on the belief that monks and nuns can look after them and feed them. Therefore, their faeces are potential sources of soil-transmitted helminth eggs and protozoan cysts posing a threat to public health.

The potential role of stray dogs and cats as reservoir for zoonotic diseases has been recognized as a significant public health concern worldwide. They release helminth eggs to the ground where

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the eggs can stay viable for long time. Therefore, soil is an important medium for parasites to contaminate and facilitate transmission to other animals and also to the human population.

In Malaysia, particularly in Penang, *Toxocara*, *Ancylostoma* and *Trichuris* eggs were found in playgrounds at 95.7, 88.3, and 77.0 per cent, respectively (Mohd Zain et al., 2015). Prevalence of helminth eggs from soil in Klang Valley, Malaysia was 23.0 % and only 3 genera of soil-transmitted helminth were found; those eggs belong to hookworm (16.6 %), *Ascaris* (4.0 %) and *Toxocara* (2.4 %) (Sandee et al., 2015).

The issue of soil-transmitted helminthiasis is not limited to Southeast Asia. Soil samples from different parks in Bucharest areas, Romania, were examined and it was found that the highest prevalence soil-transmitted species was *Toxocara* spp. (17.17 %), followed by *Trichuris* spp. (8.88 %), *Strongyloides* spp. (4.44 %) and *Toxoascaris* spp. (4.44 %) (Poliana, 2015).

The presence and distribution of soil-transmitted parasites in Thailand has never been explored. Therefore, this study aimed to provide an initial look and reference point to the whole of Bangkok area with reference to soil-transmitted parasites and their individual prevalence, particularly in temple grounds which have traditionally been "home" for stray dogs and cats.

MATERIALS AND METHODS

The soil samples were randomly collected from 95 temples in 50 districts (one to three temples per district) in Bangkok during May – October, 2016 (Fig 1). Ten areas or sites in each temple were selected based on the place where stray dogs and cats frequently live and roam from. Five square centimetre-deep sections of soil (50 g) were examined and performed double centrifugal floatation method for recovery of parasitic eggs from soil as previously described

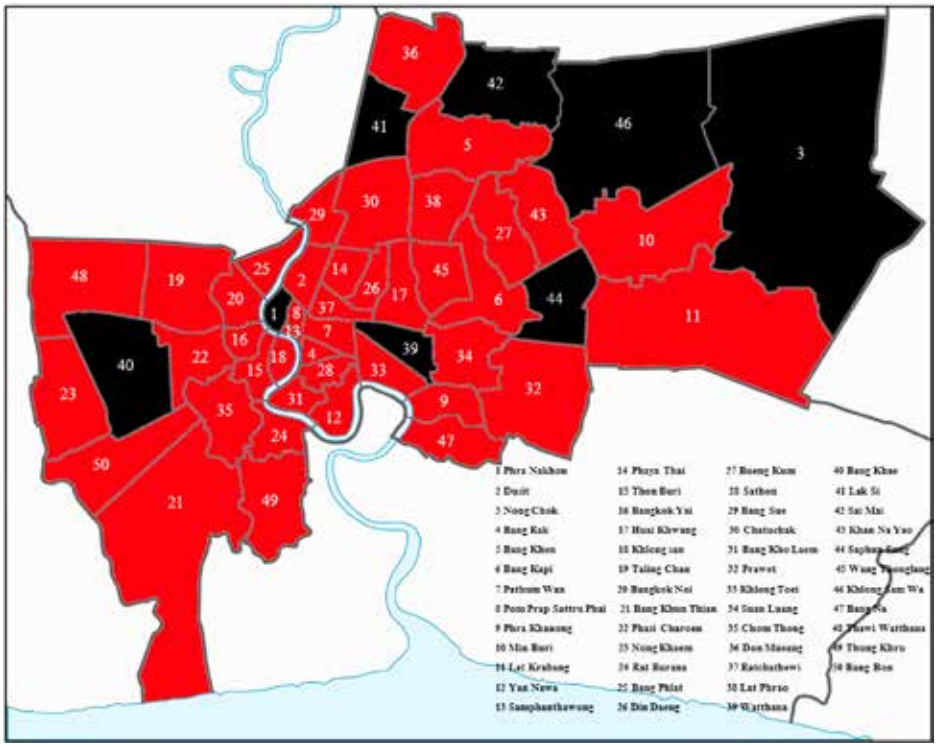

Fig 1 Study areas in Bangkok Metropolitan, Thailand covering all 50 districts (Soil-transmitted parasites infected districts are highlighted in red areas and non-infected districts in black)

(Mizgajska-Wiktor, 2005). Written permission for soil sample collection in the temples was additionally obtained from abbot in each temple.

RESULTS

Eight genera of helminth eggs, coccidian oocysts and two genera of helminth larvae were found in soil samples; these included *Toxocara* spp., *Ancylostoma* spp., *Spirocerca* sp., *Ascaridia* spp., *Eucoleus* spp., pinworm (*Oxyuris* or *Enterobius*), *Trichuris* spp., *Heterakis* spp., Coccidia (Fig 2) as well as larvae of *Ancylostoma* spp. and larvae of *Strongyloides* spp. Soil samples from 42 districts were contaminated with multiple parasites (72.0%) (Fig 1). Taling Chan District had the highest prevalence of soil-transmitted parasites found in soil specimen with 7 genera, followed by Bang Kho Leam District with 6 genera infection, 3 districts with 4 genera, 12 districts with 3 genera, 13 districts with 2 genera and 12 districts with single infection (24.0 %).

The parasites of highest prevalence were *Toxocara* eggs which were found in 32 districts (64.0 %) with 18,828 eggs per 50 grams of soil, followed by *Ancylostoma* eggs in 18 districts (36.0 %) with 54 eggs per 50 grams of soil and *Spirocerca* eggs in 15 districts (30.0 %) with 1,092 eggs per 50 grams of soil, respectively.

The district with the highest infection intensity by *Toxocara* eggs was Ratchathawi (8,895 eggs per 50 grams of soil), *Spirocerca* eggs in Sathon District (816 eggs per 50 grams of soil), *Ancylostoma* eggs were in Bang Kapi District (63 eggs per 50 grams of soil), and pinworm (*Oxyuris* or *Enterobius*) eggs in Thon Buri District (48 eggs per 50 grams of soil).

DISCUSSION

Nine hundred and fifty soil samples from 95 temples in 50 districts of Bangkok were examined to search for soil-transmitted helminth, larvae and protozoan oocysts and it revealed that 14% of soil samples were contaminated by parasite eggs/cysts. Similar surveys have also been conducted in developing countries including Brazil (Korkes et al., 2009), Czech Republic (Dubná et al., 2007), Nepal (Rai et al., 2000), Philippines (Horiuchi et al., 2013) and Malaysia (Mohd Zain et al., 2015) where 19.0-95.7% of soil samples were contaminated with parasites eggs/cysts. Detection of soil-transmitted parasite eggs/cysts in soil of temples suggested that people exposed to temple

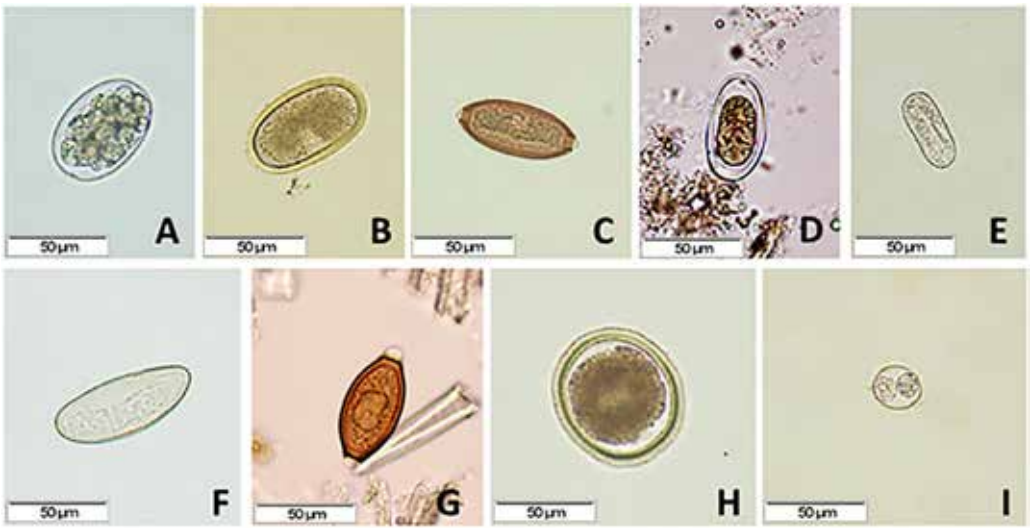

Fig 2 Microscopic images of parasite eggs and cysts found in the soil samples (A) *Ancylostoma* spp.; (B) *Ascaridia* spp.; (C) *Eucoleus* spp.; (D) *Heterakis* spp.; (E) *Spirocerca* sp.; (F) pinworm; (G) *Trichuris* spp.; (H) *Toxocara* spp.; and (I) Coccidia

Table 1 Result of helminthic eggs found in soil samples in each district

District	No. of positive/ No. of sample (%)	Overall egg counts/ 50gm of soil
Bang Bon	4/20 (20.0)	1,860
Bang Kapi	4/20 (20.0)	780
Bang Khae	0/20 (0.0)	0
Bang Khen	2/30 (6.7)	14 and oocysts
Bang Kho Laem	6/20 (30.0)	396
Bang Khun Thian	4/20 (20.0)	72
Bang Na	4/20 (20.0)	432 and oocysts
Bang Phlat	2/20 (10.0)	12 and oocysts
Bang Rak	1/10 (10.0)	228
Bang Sue	0/20 (0.0)	0 and oocysts
Bangkok Noi	3/10 (30.0)	264
Bangkok Yai	2/10 (20.0)	1,308
Bueng Kum	2/20 (10.0)	48
Chatuchak	1/20 (5.0)	36
Chom Thong	3/10 (30.0)	132
Din Daeng	1/20 (5.0)	144
Don Mueang	4/20 (20.0)	72 and oocysts
Dusit	4/20 (20.0)	156 and oocysts
Huai Khwang	3/10 (30.0)	25,152
Khan Na Yao	3/20 (15.0)	144
Khlong Sam Wa	0/30 (0.0)	0
Khlong San	1/10 (10.0)	24
Khlong Toei	6/20 (30.0)	456
Lak Si	0/10 (0.0)	0
Lat Krabang	1/30 (3.3)	0 and oocysts
Lat Phrao	2/30 (6.7)	12 and oocysts
Min Buri	3/30 (10.0)	0 and oocysts
Nong Chok	0/30 (0.0)	0
Nong Khaem	2/20 (10.0)	264
Pathum Wan	2/20 (10.0)	288
Phasi Charoen	4/20 (20.0)	132
Phaya Thai	4/10 (40.0)	816
Phra Khanong	9/20 (45.0)	372
Phra Nakhon	0/10 (0.0)	0
Pom Prap Sattru Phai	3/30 (10.0)	84
Prawet	2/20 (10.0)	276 and oocysts
Rat Burana	4/20 (20.0)	168
Ratchathewi	12/30 (40.0)	9,027 and oocysts
Sai Mai	0/30 (0.0)	0
Samphanthawong	4/20 (20.0)	144
Saphan Sung	0/10 (0.0)	0
Sathon	5/20 (25.0)	9,348

Table 1 (*Continued*)

District	No. of positive/ No. of sample (%)	Overall egg counts/ 50gm of soil
Suan Luang	1/10 (10.0)	24
Taling Chan	6/20 (30.0)	552
Thawi Watthana	1/20 (5.0)	24
Thon Buri	2/20 (10.0)	1,488
Thung Khru	1/10 (10.0)	120
Wang Thonglang	3/10 (30.0)	96
Watthana	0/10 (0.0)	0
Yan Nawa	2/20 (10.0)	144
Total	133/950 (14.0)	

soil may experience a substantial health risk for these parasites.

Soil samples from 42 out of 50 districts (84.0%) in Bangkok were contaminated with parasite eggs/cysts (Fig 1). This result provides an important information regarding the presence of soil-transmitted parasites which may widely spread in environmental soil samples in temple ground of Bangkok Metropolitan area. Three nematodes found in the current study were zoonotic parasites (*Toxocara*, *Ancylostoma* and *Trichuris*) that are potentially capable of infecting human host.

On the other hand, *Ascaridia* eggs and *Heterakis* eggs were also found in soil samples, obviously leaking into the soil from feces of wild birds as well as domesticated ones in the temple grounds. However, these parasites are exclusive to birds and cannot be transmitted to animals or humans.

Even though, stray dogs and cats feces were not directly examined in this study. The results implied that soil of temple ground may be contaminated from stray animals presented. These results essentially corroborate Morakot et al. (2006) who reported 75.0% overall prevalence of gastrointestinal parasites from dog feces in 8 districts of Bangkok and Jittapalapong et al., (2007) who reported the prevalence of 11.9% gastrointestinal parasites from cat feces in 50 districts of Bangkok where *Toxocara* and *Ancylostoma* were found to be the most frequent and dominated infection.

The present study revealed a higher infection rate of nematodes especially with *Toxocara* and *Ancylostoma* eggs were likely to be associated with temple ground being exposed to stray animals defecating in temple areas. These animals freely roam and defecate frequently on the temple ground, thus contaminating the soil with their eggs that can survive for longer period of time (Zibaei et al., 2010). This indicates that stray animals are important sources of zoonotic parasites infections as well as environmental contamination. However, molecular approaches are required to identify helminth species from soil samples, remarkably the identification and host origin of *Toxocara* and *Ancylostoma* as potential zoonotic parasites.

From a public health perspective, the potential zoonotic parasites found in this study could alert public health agencies, veterinarians and people who live nearby temples to the necessity of deworming program in stray animals in order to prevention and control of parasites as well as to reduce the environmental contamination with infective eggs and larvae.

In conclusion, this is the first study of

soil-transmitted helminth eggs and larvae recovered from soil samples taken from temples in every Bangkok districts, giving an idea about the distribution of parasites in the Bangkok Metropolitan area. For the area infection, genera of parasites and egg counts, this information might be useful for raising awareness for people who share areas with animals in temples and also highlights the issue of public health concerns in the future.

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