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Research Article

Public Health Significance of Pets: Case of Dogs

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Abstract

This study examined the role of puppies in the epidemiology and public health importance of *Toxocara canis* in Grenada. The objectives were (1) to determine the prevalence of *T. canis* in dogs under 1 year of age; (2) to understand the human-puppy relationship, (3) to determine the knowledge, attitudes and practices regarding *T. canis* and its zoonotic potential amongst puppy owners, veterinarians, physicians and 6th term veterinary students. Three hundred and six fecal samples were collected from the ground from households in all 6 parishes in Grenada and samples were placed in plastic containers, submerged in 10% formalin and stored at 4°C until being examined using a fecal floatation technique with centrifugation. Parasite eggs and larvae were visualized under the microscope at 40X magnification. Questionnaires were used to determine knowledge, attitudes and practices regarding *T. canis* and its zoonotic potential. Results showed that 48% of the puppies were positive for *T. canis;* 57% of puppies < 7 months of age and 9% of puppies > 7 months were positive respectively. *T. canis* eggs first appeared in puppies at 2 weeks age. The oldest infected puppies were 10 months old. All puppy owners interviewed had never treated their puppies, 95% never spayed or neutered their adult dogs, 64% allowed their puppies to roam free and 9% clean up after their puppies. Of all physicians interviewed, 16.7% inform patients about zoonotic disease potential, none have ever diagnosed toxocariasis in adults or children in Grenada, and 60% cited 'no concern' regarding the zoonotic potential of *T. canis* to their patients. Of the 6th term students interviewed, 6.5% ranked a 'significant concern' regarding the zoonotic potential of *T. canis*, 3.3% were aware of the four clinical toxocariasis syndromes in humans and 64.5% correctly identified the main route of transmission to humans. Results reveal that puppies present an enormous potential zoonotic threat to public health across Grenada, and that the zoonotic nature of *T. canis* and its public health importance needs improvement. Much can be gained by improving knowledge of this zoonosis to ensure better health for puppies and people. To impact the public health importance of *T. canis*, studies on the prevalence of the syndromes produced in humans are required.

Keywords: *Toxocara canis;* Grenada; toxocariasis

Introduction

Toxocara canis (*T. canis*) is a globally distributed gonochoristic helminth and cause of one of the most neglected zoonotic diseases in humans, toxocariasis [1]. *T. canis* reaches maturity in the intestine of its definitive host, *Canis familiaris* (dog). *Toxocara* eggs are voided into the environment through dog feces where they become infectious to a wide range of paratenic hosts including humans [2] *Toxocara canis* is transmitted to humans horizontally through direct ingestion of infectious eggs from the environment [3]. After ingestion, the released larvae penetrate the intestine of the paratenic hosts and can migrate to the liver, lungs, eye and central nervous system causing both mechanical and immunopathological damage [4]. Once infected, the resulting larval migration inside the human circulatory system can result in any of the four clinical syndromes of toxocariasis; visceral larva migrans (VLM) or visceral toxocariasis (VT), ocular larvae migrans (OLM) or ocular toxocariasis, covert toxocariasis (CT) and neurotoxocariasis (NT) [5,6]. Children are most at risk of developing toxocariasis due to their closer contact with contaminated soil in public parks, playgrounds and beaches [4,7] and their lack of proper hygiene [8]. In the U.S., seventy individuals lose their sight every year resulting from OLM and most of them are children [9]. Climate is a risk factor for toxocariasis [10].

Soil-transmitted helminths such as *Toxocara canis* are highly affected by surface temperature, altitude, soil type, and rainfall [11]. *Toxocara canis* exposure has been estimated to be 4% to 31% in developed countries and may increase to 86% in tropical regions, where environmental conditions favor their transmission [12]. Hot and humid environments such as Grenada, help to keep *Toxocara canis* eggs viable in the soil and therefore increases toxocariasis prevalence in all its forms [13].

Four studies in the past eight years have explored the parasite prevalence in Grenada [12-15]. Each study determined the parasite load of dogs across Grenada and found evidence of a variety of helminths including: *Ancylostoma caninum, Diofilaria immitis, Strongyloides stercoralis, Trichuris vulpis* as well as Toxocara canis.

No prevalence study has yet to explore the prevalence of *Toxocara canis* exclusively in Grenada nor how puppies play an especially important role in the transmission of related diseases such as toxocariasis. International prevalence studies on helminths, and on *Toxocara canis* in particular, have included fecal samples from a range of dogs across different age brackets. When prevalence data has been stratified using the age of the dogs sampled, dogs under 12 months of age demonstrated the highest prevalence of *Toxocara canis*. [14,16-18]. It has been mentioned in the results section of many studies that puppies are disproportionately responsible for contaminating the environment with *Toxocara canis* eggs [3,14,19]. One study determined that puppies can shed more than 294,000 *T. canis* eggs in a single stool [20]. Even with the prevalence data to show that puppies are preferentially infected with *Toxocara canis* larvae, no study has yet to focus on this age group exclusively and its direct connection to toxocariasis. Toxocariasis is considered a preventative infectious disease if effective and widespread steps are taken to ensure a break in the *Toxocara canis* life cycle. This paper will explore the complexities of *T. canis* as a zoonotic disease and suggest preventative measures to combat this global public health problem [21-28].

Material and Methods

Sample Size

The sample size of puppies for this study (n = 306), was determined by the number of Grenada parishes and the number of puppy litters attainable per parish, taking into account the number of puppies that survive per litter. Grenada is made up of six parishes. Of those six parishes, St. George and St. Andrew make up majority of the population: 36% and 24% respectively. In both of those parishes, given the population density, we expect to find 18-20 litters of puppies in each parish over the course of the 12 months study and 7-10 litters in each of the other four parishes. According to The United Nations Educational, Scientific and Cultural Organization, the average number of puppies that survive per litter in the tropics is 4. By multiplying our average numbers of litters by four, the sample size of n = 280 was calculated. This total was rounded up to allow for additional litters for a total sample size of n = 300.

Criteria for Sample Collection

(1) Puppies must have been born in Grenada; (2) puppies must be less than 12 months of age; (3) puppies must not have had any deworming treatment leading up to the time of sample collection.

Collection of Fecal Samples

On the ground fecal samples of at least 2g were collected by the primary investigator with wooden spatulas. Samples were preferentially derived from the top of each fresh deposit to avoid ground contamination. The samples were then placed in plastic containers, submerged in 10% formalin, labelled with a sample number and stored at 4°C until examination.

Identification of *Toxocara canis* eggs

Fecal samples were analyzed using fecal floatation technique with centrifugation. Each sample was weighed and measured 2g (+/- 0.02g). A high specific gravity solution of zinc sulfate was used to perform the fecal float with a specific gravity of 1.18 [13]. The samples were mixed with 13mL of zinc sulfate and strained using a fine mesh tea strainer.

The samples were then placed into a 15mL centrifuge tube and centrifuged at 1,200rpm for 5 minutes [15]. The centrifuged tubes were placed in a rack and additional zinc sulfate solution was added until a meniscus was created. Coverslips were placed on the meniscus and left to stand for 5 minutes. After that time, the supernatant was viewed under a microscope using 40X magnification. All parasite eggs, including Toxocara canis were identified by visualization and recorded.

Questionnaires

Questionnaires were distributed to puppy owners (n =36), veterinarians (n = 14), physicians (n = 35), and Term 6 students (n = 35) currently enrolled at St. George's University. The results were

used to assess the knowledge, attitudes, and practices surrounding zoonoses in Grenada, specifically Toxocara canis.

Results

Data was analysed using Microsoft Excel. The results showed that 147 out of 306 (48%) puppies were positive for *T. canis*. 142 (57%) and 5 (9%) of puppies < 7 months of age and > 7 months were positive respectively. The oldest puppies found infected were 10 months of age.

Of the puppy owners interviewed, 97% had not spayed or neutered their adult dogs, 68% allow their puppies to roam free and only 9% clean up after their puppies. Of the physicians interviewed, 16.7% talk to their patients about zoonotic disease potential, none have ever diagnosed toxocariasis in adults or children in Grenada, and 60% cited 'no concern' regarding the zoonotic potential of *T. canis* to their patients.

Discussion

In terms of general parasite prevention strategies, a deworming treatment schedule conducted by a veterinary professional is the gold standard recommendation. However, due to the socioeconomic realities in Grenada, deworming is not a viable preventative option. Most community members do not have access to treatment or the financial means to call upon a veterinarian for deworming treatment. Most dog owners lack the resources or knowledge to purchase treatment from a pharmacy to administer the treatment themselves effectively. Alternative strategies need to be recommended.

Our recommendation therefore, is that dog owners be encouraged to pick up after their puppies and dispose of the feces appropriately. *T. canis* eggs need 2-3 weeks in the environment before they mature into their infective L3 stage. Removing the feces immediately after excretion is an affordable and highly effective method of preventing environmental contamination and therefore, potential disease transmission to humans. Educational efforts need to focus on this approach. As was seen in the questionnaires, only 9% of dog owners picked up after their dogs. Therefore, there is potential to make a big difference in this area.

Limitations and Strengths

One limitation of the study is that all fecal samples were stored in 10% formalin for a prolonged time until lab analysis of the samples can be conducted. The gold standard for the fecal flotation technique is to use fresh fecal samples, less than 24 hours old [13]. Multiple samples in this study were stored for weeks to months old which may have affected the quality of sample and investigator's ability to visualize *Toxocara* canis eggs and other parasite eggs.

A strength of the study was that fecal samples were collected from all six parishes in Grenada, and from many different communities within each parish. This effort was to ensure a representative sample for this study. The large sample size was another strength which helped to give our results validity.

Conclusion

Puppies infected with *T. canis* excrete millions of eggs daily. Given this high prevalence coupled with prolonged shedding, puppies present an enormous zoonotic threat to public health across Grenada. Awareness of this threat is poorly appreciated by all groups interviewed and much can be gained by improving knowledge in these areas. Research on the prevalence of toxocariasis syndromes in humans in Grenada is required to complete the one health triad and gain an accurate picture of the public health threat in its entirety. Only then can all parties involved create and implement successful prevention strategies to ensure better health for people and puppies.

Declaration of Interest

None.

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