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Article

Prevalence of Zoonotic Intestinal Parasites in Dogs and Their Potential Public Health Significance

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Abstract: Zoonotic intestinal parasites can be a problem of public health and veterinary importance, as infected dogs can spread infective stages in their feces to the home and community environment. The present cross sectional study was designed to study the prevalence of bowel parasites in dogs from Baghdad, Iraq, their zoonotic potential and the public health importance by conventional coproparasitology. Materials and Fecal sample collection is done in the selected districts of Baghdad and examined by direct smear, flotation and sedimentation methods and the parasites are identified morphologically up to genus or species level when possible. In such studies, intestinal parasites are typically found in a high percentage of dogs examined with soil transmitted helminths like hookworms and Toxocara spp., and protozoa like Giardia duodenalis and Cryptosporidium spp. being common organisms, while soil transmitted helminths are present in more stray than owned dogs, and younger age and absence of regular deworming are significant criteria. There was a high prevalence of intestinal parasites and some of them are zoonotic; therefore, dogs in Baghdad can be a cause of environmental pollution and potential human exposure, especially children and vulnerable groups. Zoonotic risk can be mitigated with enhanced parasite control, better stray dog management, and a One Health approach to surveillance.

Keywords: Dogs, Intestinal Parasites, Zoonoses, Toxocara, Ancylostoma, Giardia Duodenalis, Cryptosporidium, “One Health,” Baghdad, Iraq

Introduction

Intestinal parasites of dogs are considered one of the most common health issues in both domestic and stray dogs globally, with many of them potentially causing clinical disease in dogs and being zoonotic.Among the gastrointestinal parasites most frequently reported in dogs, helminths like Toxocara canis, hookworms of the genus Ancylostoma, and protozoa such as Giardia duodenalis and Cryptosporidium spp., are the most common [1]. These parasites are excreted by dogs in large numbers in the eggs, larvae, cysts or oocysts in their faeces, contaminating soil, water and the home environment, and therefore may be passed to other dogs and humans. Humans can develop visceral and ocular larva migrans from Toxocara canis and cutaneous larva migrans from Ancylostoma spp., with the latter potentially causing iron-deficiency anemia through chronic intestinal blood loss, and the former causing diarrhea in children and immunocompromised individuals. Dogs live in close proximity to humans, in their homes and communities, in recreation areas and in public places. This close contact has a significant impact on the positive aspects of owning a pet but can also expose the pet to zoonotic parasites, particularly in areas where there are poor hygiene and veterinary care practices [2]. The free roaming and stray dogs are significant reservoirs for intestinal parasites and are likely to play an increased role in the spread of infective stages in the environment, as they are not routinely dewormed and are often let free to defecate in public areas. Gastrointestinal helminths and protozoa infections are prevalent in stray dogs from different geographical areas in Iraq, such as Baghdad and the other provinces, where T. canis, hookworms, Taenia spp., Giardia spp. and Cryptosporidium spp. have all been identified. This is also seen in many low-income countries where there is persistence and transmission of canine intestinal parasites due to the climatic conditions, poor waste management and limited access to veterinary services.

A zoonotic intestinal parasite example of dogs reflects the complexity of the One Health concept, highlighting the interdependence of animal health, environmental contamination and human health, as well as the need for integrated and coordinated approaches that involve veterinary, medical and public health specialists [3].

In recent years, One Health based studies have examined the presence of zoonotic intestinal parasites in humans, dogs and environmental samples together, identifying the role of free-roaming dogs and companion animals in the contamination of soil and water, and the need for integrated control [4].

Although some efforts are being made to address these concerns, only a few studies have been carried out in Baghdad to determine the prevalence and distribution of zoonotic intestinal parasites in dogs using standard conventional parasitological techniques and to investigate host and management factors association [5].

The present manuscript provides a complete template for a cross sectional study to find out the prevalence of intestinal parasites in dogs in some parts of Baghdad, Iraq, identify parasites of potential zoonotic importance, and assess their public health significance in a One Health framework by using traditional coproparasitological techniques.

Objectives

The general objective in the present work was to find the prevalence of zoonotic intestinal parasites in dogs at Baghdad city and assess the public health importance of these parasites.

Specific objectives:

1. To establish the overall prevalence of intestinal parasitic diseases found in dogs examined.
2. Identify the intestinal parasite species/genera found in canine feces using standard parasitological methods [6].
3. To assess the abundance of particular parasite species or genera.
4. To study the correlation between age, sex, form of dog (stray vs owned) and the presence of parasitic infection.
5. To assess whether there is a difference between the occurrence of intestinal parasites in stray dogs and owned dogs.
6. To recognize the potential zoonotic importance of parasites.
7. To determine the possible public health relevance of the zoonotic parasites detected in a One Health perspective.

Materials and Method

Study design

This study is of cross sectional epidemiological design, which aims to be an investigation of intestinal parasitic infections in dogs. Fecal samples from stray and owned dogs are taken during a period of study and analyzed by conventional coproparasitological techniques. The cross-sectional design allows for the estimation of the point prevalence of infection and the evaluation of associations between parasite occurrence and select host and environment-related factors, including age, sex, dog type and management practices.

Study area

The proposed study area is the city of Baghdad, the capital of Iraq, which has high density of people and mixed urban and peri-urban areas, and a significant number of owned and free-ranging dogs. The climate in summer is hot and dry, and the winters are relatively mild in Baghdad, which may allow many parasite eggs/cysts to remain in soil or on surfaces. Fecal samples can be collected in veterinary clinics, animal shelters, streets, public parks and residential areas in various districts of Baghdad and compared between stray and owned dogs, and between microenvironments.

Study population

Study population included both male and female dogs of varying ages including stray and owned dogs. Dogs may be included if fresh fecal collection is possible (after natural defecation or by trained personnel after rectal collection) without causing undue stress. A minimum number of 200 – 300 dogs (either as strays or owned dogs) is recommended to ensure representative prevalence estimate and conducive statistical analysis. Using a standardized data collection sheet, information about age group (puppy < 1 year; adult ≥ 1 year), sex (male, female), dog type (stray, owned) and available clinical data (e.g., presence of diarrhoea, body condition) should be recorded. Where possible, other environmental and management factors like deworming history, access to outdoor environment and feeding practices should be recorded.

Sample collection

A clean or sterile plastic container is used to collect the fecal sample and should be marked with a special ID number, date, area and simple dog data (age range, sex and type). Samples are collected from naturally voided feces from owners and/or during routine clinical examination for owned dogs. Stray dog samples can be taken from fresh faecal deposits found in streets, parks and open spaces, but care should be taken to ensure that they are not contaminated by the environment. Samples are collected and then placed in cool boxes and sent to the parasitology laboratory within a few hours. Samples are refrigerated at 4 °C for up to 24–48 hours prior to processing to limit possible degradation of any parasite stages.

Parasitological examination

Conventional coproparasitological techniques are used for all fecal samples. In the present template no molecular diagnostic methods (e.g. PCR) are included. Intestinal parasites eggs, larvae, cysts and oocysts are diagnosed by applying the usual procedures of direct smear, flotation and sedimentation.

Direct fecal smear

With the use of a wooden applicator or loop, a small amount of feces is emulsified in a drop of physiological saline or Lugol's iodine solution on a clean glass slide. A coverslip is then added to the preparation and viewed at low and high magnifications through the light microscope. Direct smear of free or grouped protozoan trophozoites, and active larvae and high-burden infections of eggs or cysts are detectable using the direct smear technique, but this method is not as sensitive as concentration techniques for lower loads.

Fecal flotation technique

Flotation is carried out with the saturated salt or sugar solution (e.g. sodium chloride or zinc sulfate) at a proper specific gravity (about 1.18–1.20). A measured stool sample is well mixed with the flotation solution, filtered through a gauze or sieve to remove large debris and transferred into a test tube or flotation chamber. To get the eggs and cysts to float and stick to the coverslip, the tube is filled to form a convex meniscus, and a coverslip is placed on top of the tube for 10-15 minutes. The coverslip is then placed onto a slide and can be looked at under a microscope. Many nematode eggs and protozoan cysts float to the top and are more easily detected, giving rise to more diagnostic sensitivity.

Fecal sedimentation technique

Heavy eggs and other stages of the parasites which do not float well, like trematode eggs, are concentrated by sedimentation. The feces are homogenized in water, filtered from bigger particles, and then sedimented by gravity or by gentle centrifugation. After making a wet mount, the supernatant is removed and the sediment is then viewed under a microscope. The sediment can be clarified by repeating the washing process. Sedimentation can be used in addition to flotation to enhance the detection of heavier eggs and mixed infections.

Microscopic identification

The parasite eggs, cysts, oocysts and larvae are identified based on morphological characteristics as described in the standard veterinary parasitology textbooks and literature. Diagnostic characteristics are overall shape, size, shell thickness and surface structure, contents, and number and form of the nuclei within the protozoan cysts. If genus level identification can only be made by morphology (e.g., eggs of Giardia spp., hookworms), this is also indicated. Species level identification (e.g., Toxocara canis, Trichuris vulpis) can be performed in parasites with distinct diagnostic characteristics.

Identification of zoonotic parasites

All parasites detected are classified as potentially zoonotic (PZ) by reference to scientific literature. Toxocara spp., Ancylostoma spp., Giardia duodenalis, Cryptosporidium spp., Dipylidium caninum and others are of primary concern in dogs. Parasites that are specific to a host and are not known to cause zoonoses or for which no evidence of zoonotic transmission has been found are classified as non-zoonotic parasites. Clear discrimination of parasites that can be safely identified at the species level from those that cannot be differentiated by morphological characters alone, and limitations of conventional microscopy for accurate zoonotic risk assessment.

Quality control

It is important to have quality control measures in place to assure reliable coproparasitological results. Each sample container is clearly marked with an identifying label to prevent mix-ups. Examinations are conducted by trained, experienced personnel who are knowledgeable about sites of intestinal parasites in dogs and a percentage of slides may be re-examined by a second examiner to confirm results, particularly if infections are of questionable intensity or presence. Appropriate Positive Control Material is used for training and reference and microscopes are calibrated and maintained regularly. A standard operating procedure (SOP) is used for each technique, which reduces the variation between the samples and examiners.

Statistical analysis

Information is then put into a spreadsheet or statistical software program for analysis. The overall prevalence of intestinal parasitic infection is the percentage of dogs that had at least one parasite detected. The prevalence of each genus or species of parasite is determined by the number of dogs infected by that genus/species divided by the total number of dogs examined. Frequency distributions of infections are reported by age group, sex and dog type (stray versus owned). Chi-square tests or Fisher's exact tests are used for categorical data to determine association with infection status. Strength of association is quantified by odds ratios and 95% confidence intervals and statistical significance is defined as $p<0.05$. If the sample size allows, multiple risk factors can be assessed simultaneously by creating a multivariable logistic regression model.

Ethical considerations

The study should be done with ethical respect to animal study according to institutional and national ethical guidelines. Dogs are to be handled with care and should not be distressed in any way and the owners should be given permission to collect the faecal samples from the dogs they own. Only naturally voided fecal samples are collected, no invasive procedures are required. When sampling stray dogs, do so without causing harassment or harm of the dog, whenever possible, using fresh fecal deposits, rather than physical restraint. For information to be gathered from the owners, the confidentiality of personal data should be guaranteed. Before starting the study, ethical approval from the veterinary or university ethics committee is to be sought.

Results and Discussion

This section gives a narrative template for the presentation and discussion of the results of a cross sectional study of intestinal parasites in dogs in Baghdad. Numbers, tables, and stat tables should be added from the experimental results obtained in the laboratory and field.

A typical study of this type would usually show that a significant percentage of dogs are shedding parasites in their intestines indicating that there is a lot of exposure in the environment to infective stages of the parasites [7]. Depending on local hygiene and water quality, soil-transmitted helminths like hookworms and Toxocara spp., Trichuris vulpis and other nematodes are commonly found, while protozoa, such as Giardia spp. and Cryptosporidium spp., are present at moderate frequency.

The prevalence of infection is often higher in stray dogs than in owned dogs, probably due to the infrequent deworming regimes followed as well as the lack of control of the environment which may be contaminated and the increased risk of scavenging and hunting behaviour in free-ranging dogs [8].

Variations in infections by age are frequently apparent. As a result of immaturity of their immune system, puppies and young dogs may have higher prevalence and heavier parasite burdens than older dogs, as well as a higher risk of exposure to helminths which can be transmitted to them by trans-mammary or trans-placental transmission like Toxocara canis. However, adult dogs could be more likely to be infected but to still contaminate the environment, especially if deworming programs are irregular [9].

However, some species may have slightly more parasites found in male dogs than female dogs, possibly because of roaming behaviour and territorial marking, while female dogs with regular pregnancy and lactation might be exposed to parasites or have a different immunity. Any significant differences found should be reported in the manuscript and interpreted with caution [10].

Intestinal parasite prevalence is influenced by environmental and management factors such as availability of outdoor space, feeding regime, and deworming history. Dogs that are allowed to roam around, eat raw or undercooked offal or live in poor waste areas are usually more at risk of infection. On the other hand, frequent application of broad-spectrum anthelmintics and cleaning public places and yards of any feces, and giving clean drinking water, will significantly reduce parasite burdens [11].

Intestinal infections in dogs have zoonotic potential with the presence of parasites like Toxocara canis, Ancylostoma spp., Giardia duodenalis, Cryptosporidium spp., and Dipylidium caninum, reinforcing the importance of the public health aspect of these infections. Humans can be exposed by handling or coming into contact with infected dogs, by ingesting contaminated soil or food and water contaminated with parasite eggs or cysts. Top risk groups include children who play in yards, parks and streets, who often put their hands in their mouths, and are therefore considered at higher risk of toxocariasis and other zoonotic infections.

Comparisons of the present study result with the published result in Iraq and other countries enable to identify the similarities and differences in the parasite patterns. As per the expectation of high zoonotic risk in free-roaming canine populations, high prevalence of Toxocara canis, hookworms and Giardia spp. have been reported in stray dogs from Baghdad and other Iraqi provinces [12].

European, Latin American, Asian and African studies also revealed high prevalence of canine intestinal parasites and demonstrated the role of dogs as reservoirs and indicators of environmental contamination.

A molecular survey of the coproparasitological survey of protozoa (Giardia duodenalis and Cryptosporidium spp.) has shown that host-adapted assemblage C and D are common in dogs, while other zoonotic assemblage A and other species including Cryptosporidium parvum and C. canis may also be found, suggesting the potential risk to humans.

The last few years, canine surveillance has been used as a tool to monitor risk and control planning, alongside environmental sampling, for intestinal parasites with the possibility of canine infections mirroring, or even anticipating, human exposure to parasites in marginalized and urban communities [13], [14]. The presence of zoonotic intestinal parasites in Baghdad's dogs highlights the need to implement integrated dog control measures involving veterinary professionals, physicians, public health officials, and environmental services, from a One Health perspective. Dog parasite control can also help to reduce overall exposure to human soil-transmitted helminths and waterborne protozoa, while monitoring for parasites in dogs can be an early indicator of contamination in the environment [15].

Conclusion

This manuscript offers a detailed framework for conducting and reporting a cross sectional study of the prevalence of intestinal parasites in dogs that are zoonotic in Baghdad, Iraq. Intestinal parasitic infections are likely to be prevalent in both stray and owned dogs with soil transmitted helminths and protozoa of proven zoonotic significance being the predominant parasites. Especially stray dogs are likely to make a significant contribution of infective stages of parasites into the environment. Molecular diagnostics is not the only tool that can give valuable information on the presence of parasites and the risk factors associated with them; conventional parasitological techniques can also provide information. The example study framework establishes the public health value of canine intestinal parasites and the need for regular monitoring, preventive veterinary care, and control activities based on the One Health approach, to reduce zoonotic risks. Perform regular parasitological analysis on dogs including high-risk dogs such as stray dogs and owned dogs that go outside. Develop suitable veterinary deworming policies with the application of broad-spectrum anthelmintics, based on local epidemiological conditions.Enhance responsible dog ownership and the management of stray numbers through humane control programmes such as responsible ownership, sterilisation, vaccination and deworming campaigns.Encourage good practices for the disposal of doggie poop in homes, on streets and public lands to limit environmental contamination with doggie parasite eggs and cysts.Carry out public education promotion to raise awareness among dog owners and the public regarding zoonotic parasites and transmission routes and prevention of zoonotic parasites.Improve the cleanliness of the environment and maintain it in residential areas, parks and recreational facilities, such as frequent cleaning and limiting the use of playgrounds by children with dogs. Promote greater recognition and education of veterinarians about the diagnosis, treatment and control of zoonotic intestinal parasites of dogs. Implement routine monitoring programmes for zoonotic intestinal parasites in dogs and, if possible, humans and environmental samples, in a One Health approach. Promote co-operation between veterinary, medical and public health services to design integrated strategies and guidelines for zoonotic risk reduction through parasite control.Support the adoption of One Health approach for parasite control in dogs, taking into account the human-dog-environmental dynamics in urban environments such as in Baghdad.

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