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Prevalence of Canid Gastrointestinal Helminths Eggs in Soils from Playgrounds within the Kisii Municipality, Kenya

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Research Article

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ABSTRACT

Human zoonosis threatens public health disease surveillance, management, control and eventual elimination. Nowadays, people and pets share private and public utilities oblivious of the potential risk of zoonotic pathogen transmissions. Toxocariasis is one of the most prevalent zoonotic helminthic infections that are transmitted by cats and dogs through soils contaminations. The present study sought to determine the extent at which soils from playgrounds in Kisii municipality, Kenya are contaminated with eggs of canid gastrointestinal helminths. The wandering quarter method was used to collect soil samples from playgrounds in Nyamataro, Daraja Mbili, Nubia and Jogoo areas. Zinc sulphate floatation method was used to separate ova, cysts and larvae that were observed microscopically. Fifty five (55) out of 84 (65.5%) samples were found to be positively contaminated with canid gastrointestinal helminths (P <0.001) where 37/55 (67.27%) were contaminated with either *Toxocara* sp., *Ancylostoma* sp. or *Strongyloides* sp. while 18/55 (32.73%) were contaminated with mixed helminths; *Toxacara* sp. and *Ancylostoma* sp. (33.3%) or Toxacara sp. and *Strongyloides* sp. (66.6%). *Toxocara* sp. being the most prevalent helminth in all the samples collected (56.8%; P <0.001). Results show that soil samples from play grounds within the Kisii municipality were contaminated with a variety of canid gastrointestinal helminths. Therefore, it implies that the population is at risk of intermittent zoonotic epidemic outbreaks. Necessitating implementation of mass treatment and public health programmes to treat infected animals and educate the population of the possibility of acquiring saprozoonoses.

Globally, zoonosis accounts for 75% of emerging and re-emerging human infectious diseases[1]. Zoonoses are diseases that were naturally transmissible between animals but now are expanding to infect humans. The infections are acquired through ingestion of infective stages or consumption of contaminated water or foodstuffs or being exposed to soils contaminated with zoohelminths[2, 3]. In homes, home yards and playgrounds, cats, dogs as well as exotic pets are the common sources of zoonotic infections[4-6]. Keeping of pets has been established to be psychologically therapeutic by providing positive influence, emotional and physical benefits[7-12]. However, cats and dogs have been largely implicated in transmission of common parasitosis like toxocariasis, toxoplasmosis, ancylostomiasis and giardiasis worldwide [13-15]. In developed and developing countries, municipalities provide playgrounds and home yards that are utilised by pre-school and school going children. However, more often than not dog and cat have been documented to frequent these grounds to defecate[16]. In Kenya, cats and dogs are commonly seen on children's playgrounds and yards where they freely roam and defecating leading to deposition of ova, eggs and cysts in the soils. Therefore, the play grounds act as reservoir of felid and canid gastrointestinal helminths eggs and cysts[17, 18].

Human toxocariasis is an incidental infection caused by either dogs or cat roundworms[19] through ingestion of embryonated eggs in soils, formites or foods[3]. The ingested larvae migrate through hosts vital organs resulting in disease conditions like

eosinophilic meningoencephalitis (EME), covert toxocariasis (CT) and neurotoxocarosis[20, 21]. In developing countries of the Americas, Asia and sub-Saharan Africa, high prevalence of toxocariasis have been reported[22–24]. For instance, toxocariasis in Kenya is regarded as one of the most neglected parasitic infections but cases of infection were documented two decades ago in Turkana country[25]. Since then, there have been no studies undertaken to determine the potential environmental sources to transmit infections, the role of cats and dogs in saprozoonoses, and the extent at which the environmental is contaminated with felid and canid zoohelminths. Thus, the status and endemicity of toxocariasis in Kenya still remains unknown despite studies being conducted in other parts of the globe. Cats and dogs have been implicated in playing a significant role in the contaminating soils around poor peri-urban and urban environments[17,18,26–36]. Therefore, the present study sought to determine the extent at which soil from playgrounds within Kisii municipality is contaminated with eggs of felid or canid gastrointestinal helminthes.

METHODS AND METHODS

Study Site and Population

Kisii County is located on the western part of Kenya where it lies on 0.6833°S, 34.7667°E covering an area of 1318 km^2 with an estimated population of 1,152,282 people according to 2009 census report[26]. The population of the municipality corresponds to 17.4% of the population in the Kisii County, where approximately 8.7% live in urban areas and 45% are under the age of 14 years[37]. Kisii County has a dry and wet tropical highland climate with short rains in September to November and long rains from February to June, of over 1500 mm per annum that are favourable for transmission of parasitic diseases. The municipality has 8 play grounds and play yards of which are used by pre-school and school going children. The current increase in puppies, stray dogs and cats coupled with a 2.7% increase in human population have negatively affected the status of the playgrounds. The Nyamataro, Jogoo, Nubia and Daraja Mbili playgrounds were selected as sampling points due to their proximity to human-dwelling places and schools, are easily accessible by both children and animals and located in the densely populated areas of the municipality.

Sample Collection

The wandering quarter technique[38] was used to collect the soil samples. Transects of random direction & random starting points were selected from a point and the closest soil sample within ninety degrees was collected. Samples of 20-25 grams were collected from each play yard. The soils were dried for 7-10 days at room temperature and sorted and sifted through sieves of different mesh sizes to remove debri, twigs and leaves. Duplicate samples of the fine soil collected were processed by standard centrifuge floatation technique (CFT) utilizing zinc floatation for concentrating and recovery ova and cysts[39]. Duplicate microscope slides were prepared and stained with Lugol's iodine and examination and quantification of ova, cysts and larvae of zoonotic gastrointestinal helminths.

STATISTICAL ANALYSIS

The prevalence of zoonotic gastrointestinal helminths from cats and dogs in the four selected children's play grounds was done using X_2 tests using IBM statistical package for social sciences software (IBM-SPSS) (version 21 for windows). The levels of significance of less than 0.05 were considered significant at 95% confidence interval (CI).

RESULTS

Samples collected from play grounds in Nyamataro, Daraja Mbili, Nubia and Jogoo were 65.5% (55/84) contaminated with canid gastrointestinal helminths (*P* <0.001) (Table 1). Nyamataro had 11/21 (52.38%), Jogoo 12/21 (57.14%), Nubia 17/21 (80.95%) and Daraja Mbili 15/21 (71.43%) **(Table 1).**

Table 1. Prevalence of canine gastrointestinal helminths in soil samples from playgrounds within Kisii municipality, Kenya.

Play ground	Samples collected	Frequency of canid zoohelminths (%)	P-value
Nyamataro	21	11/21 (52.38)	*P* <0.001
Jogoo	21	12/21 (57.14)	*P* <0.001
Nubia	21	17/21 (80.95)	*P* <0.001
Daraja Mbili	21	15/21 (71.43)	*P* <0.001
Total	84		

Thirty seven samples (37/55) (67.27%) were contaminated with more than one species of canid gastrointestinal parasites and 37.72% (18/55) were contaminated with mixture of species **(Table 2).**

Table 2. Samples positive with single helminth contamination.

Helminth species	Positive samples (n)	Level of contamination (%)	P-value
Toxocara sp.	21	56.8	*P* <0.001
Strongyloides sp.	14	37.8	*P* <0.001
Ancylostoma sp.	2	5.4	*P* <0.001
Total	37	100	

Morphometric identification showed that *Toxocara* sp. 21/37 (56.8 %) and *Strongyloides* spp. 14/37 (37.8%) were the most prevalent species in the soil samples collected. *Toxocara* sp. and *Ancylostoma* sp. were mixed in 6/18 (33.3%) of the samples as opposed to *Toxocara* sp. and *Strongyloides* sp. 12/18 (66.6%) **(Table 3).** Overall, the levels of significance in relation to the number of helminth species in the playgrounds and amongst the soil samples were statistically different (*P* <0.001).

Table 3. Samples positive with mixed helminth contamination.

Helminth species	Positive samples (n)	Level of contamination (%)	P value
Toxocara sp. and *Ancylostoma* sp.	6	33.33	*P* <0.001
Toxocara sp. and Strongyloides sp.	12	66.66	*P* <0.001
Total	18	100	

DISCUSSION

The study reports for the first time that soil from playgrounds within the Kisii municipality, Kenya are contaminated with canid gastrointestinal helminths at an average prevalence rate of 65.5%. The prevalence rate is comparably higher than that those obtained in playgrounds of Dublin in Ireland and Bangalore in India which were less than 30%[40,41]. This implies that pre-school and school going children within the Kisii municipality that use the playgrounds are at risk of *Toxocara* infections, hookworm infections and other bacterial infections. During sampling and behaviour monitoring exercises, we observed that the children were playing and walking bare footed as well as putting the soil in their mouths. Studies have established that an exposure to *Toxocara* infection is proportionate to the prevalence of eggs in the soil samples[42,43]. In our study, we established that the level of soil contamination was comparable to the location of the playground. On the contrary, Dada and Lindquist (1979) established that locality does not influence the level of soil contamination with *Toxocara* sp. and its prevalence in public and high end residential play grounds of Kansas and Philadelphia[44].

The high prevalence rates of other helminths like the infective larval stages of *Strongyloides* sp and *Ancylostoma* sp. were also observed in the soil samples from the four playgrounds. This is an indication that the residents are at a risk of hookworm infections. Therefore, we suggest that the high prevalence of diarrhoea episodes may be due to helminths that commonly share same geographical distribution with malaria in the area and have been implicated to causes of anaemia and malnutrition in the region[45,46].

The disparity in prevalence rates amongst the playgrounds may be attributed to their proximity to dwelling places and cultural practices pertaining pet keeping. Surface water run-off through the informal settlements of Nubia and Daraja Mbili settles and deposits silt in the playgrounds of Nubia and Daraja Mbili. This can be improved by the municipality providing eco-friendly toilets and better water drainage and sanitation.

According to study findings, we concluded that children using public playgrounds were at a higher risk of infections as opposed to those who use privately maintained playground. Therefore, an urgent public health intervention of controlling stray dogs and cats within the Kisii municipality should be imposed. Entry of pets to children playgrounds and yards should be monitored. Environmental decontamination programmes should be implemented to inactivate the ova and cysts in the soils. In so doing, this will reduce the prevalence rates *toxocara*l soil contaminations significantly. Mass anti-helminthic treatments should be extended to pre-school going children in the municipality who might have been infected. This can be achieved during post-natal visits to clinics as well as home visits. However, mass treatment of pets will be the sure way of lowering the risk of soil contaminations.

CONCLUSION

Playgrounds contaminated with *Toxocara* sp. pose a risk of zoonotic infections to humans. Thus, this major public health concern necessitates for broad deworming programmes for pets and children, controlled entry by restricting access of pets into play grounds. These will improve zoonotic disease surveillance, prevention and control in Kisii Municipality.

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