THE PREVALENCE OF HELMINTH EGGS IN THE SOIL OF ABUJA RECREATIONAL PARKS AND GARDENS, ABUJA NIGERIA

BY

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May, 2011

DECLARATION

I declare that this thesis entitled "*The Prevalence of Helminth Eggs in the Soil of Abuja Recreational Parks and Gardens, Abuja Nigeria"* has been performed by me in the Department of Veterinary Public Health and Preventive Medicine.

The information derived from the literature has been duly acknowledged in the text and a list of references cited provided. No part of this thesis was previously presented for the award of another degree or diploma at any university.

_____	_____	_____
Name of Student	**Signature**	**Date**

CERTIFICATION

This thesis entitled *THE PREVALENCE OF HELMINTH EGGS IN THE SOIL OF ABUJA RECREATIONAL PARKS AND GARDENS, ABUJA NIGERIA;* by Fatima Mohammed meets the regulations governing the award of the degree of Master of Science (M.Sc) in the Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

In Nigeria and other developing countries where there is an uncontrolled population of stray dogs and inadequate veterinary care, there is a likelihood of high degree of soil contamination by geohelminth eggs. Recreational parks in Abuja receive a lot of visitors daily. Contamination of these parks with geohelminths may expose humans to infection. This study was set up to determine the prevalence of geohelminths in recreational parks in Abuja and the extent of awareness of the risk of infection by the members of the public who visit the parks. Seven recreational parks were studied out of the 28 officially approved parks in Abuja phase I. a total of 764 samples were studied using sucrose floatation medium with specific gravity 1.25. Helminth eggs were found in 68% of the soil samples studied. Park D (83%) as the highest contaminated with geohelminths. Lowest rate (47%) was observed in park A. *Toxocara* eggs (52%) were the most frequent helminth eggs, followed by *Teania* (15%), *Isosphora* (7%) and *Trichuris* (3%). Park G was the most contaminated with *Toxocara* eggs (64%) and park A (7%) the least contaminated with *Toxocara* eggs. Of the 200 persons who visited the parks during the study period and were interviewed, 184 (95%) were aware of human infection by helminthes, but only 36% were aware that helminth infection can be acquired through soils contaminated with faeces. It is concluded that soils in Abuja recreational parks are contaminated with helminth eggs. It is important that members of the public be enlightened on the risk of soil borne helminth infections.

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INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The word "Helminth" refers to a variety of worms that live in both human and animal bodies for survival. The parasites that cause helminth infections are naturally present in the environment. Some infections may be soil-borne involving nematodes such as roundworms – *Ascaris lumbricoide*; whipworm – *Trichuris trichiura;* and hookworm – *Ancylostoma spps* or water borne involving flukes such as *Schistosoma haematobium* and *Schistosoma mansoni.* Infection in both man and animal is said to manifest when helminthes are able to invade, feed and become established (WHO, 1997). Most often human and animals become infected with helminths by coming in contact with soil, water or food that contains the eggs or other stages of these parasites (Soulsby, 1987; WHO, 1997).

Companion animals play a significant role in the transmission of zoonotic diseases worldwide (Schantz, 1994). The role of dogs in the transmission of zoonotic helminth diseases cannot be over-emphasized because of the close contact they maintain with humans and other animals. Intestinal parasites in these pet animals are common pathogenic agents encountered in animal health workers and children. The close association between children and puppies play a significant role in the transmission of such parasites because though the parasites affect dogs of all ages, prevalence of the infection is mostly high in young puppies (Ramirez-Borrios *et al*., 2004).

Soil plays a significant role in the transmission and maintenance of the helminthes worldwide. Thus, soil contamination is the most direct indicator of the risk of human infection (Mizgajska, 2001).

Infection in certain part of the world is closely related to poverty and poor environmental hygiene such as lack of clean water supply, contamination of the environment by human and animal wastes and poor personal and environmental hygiene (WHO, 1997).

The poor environmental conditions of countries such as Nigeria as a result of poor personal, environmental or general hygiene and poverty (Yusuf and Husseini, 1990; Maikai *et al*., 2008), can be said to account for the presence of parasitic immature stages of these helminthes in soil and air (Lawande, 1983; Mahdi and Ali, 1993).

1.2 STATEMENT OF THE PROBLEM

A number of studies in Nigeria and worldwide have demonstrated the presence of pathogenic parasites of dogs in contaminated drinking water (Cifuentes *et al*., 1994), soil (Wong *et al.*, 1994; Maikai *et al.,* 2008), air (Lawande, 1983) and even Nigerian currency – the Naira (Amodi, 2000).

Socio-cultural and socio-economic parameters, such as contact with animals (Minveille *et al*., 1993), lack of public enlightenment (Mason and Patterson, 1994) and improper waste disposal (Oberg *el al*., 1993), are the principal sources of these faecal contaminations. The constant migration of city dwellers from rural to urban areas results in overpopulation thus, over-stretching the city facilities as well as

marginal settlements in peripheral areas where conditions that favour transmission and development of such parasites abound. The age of the host, the type of parasites and the length of infection also influence the transmission and distribution of helminthic parasites (Basualdo *et al*., 1996).WHO (2008) reported that 130 countries worldwide were considered to be endemic for soil-transmitted helminthic diseases.

Toxocariasis is an accidental human infection acquired by swallowing eggs of series of related nematode species *Toxocara. Canis* and *Toxocara. cati* that routinely infect dogs and cats respectively; throughout the world. The eggs from these ascarids are common environmental contaminants of human habitation, due largely to the fact that many kinds of dogs and cats serve as pets, while countless others run wild throughout the streets of most urban centers. Humans, particularly children are at the highest risk of infection because of pica, geophagia, and playing on soils contaminated with animal faeces (Uga & Kataoka, 1995).
There are two types of diseases caused by *Toxocara* in man; visceral larval migrant (VLM) and optic larval migrant (OLM).

The presence of infectious parasitic eggs within urban squares and public recreation areas is of a significant health risk (Uga *et al.*, 1996; Minvielle *et al.,* 2000). Human *Toxocariasis* caused by *Toxocara Canis* and *T. cati* occurs by accidental ingestion of embrayonated eggs (Despommier, 2003; Fisher, 2003). Soil which is one of the principal sources of these parasitic infections (Wong *et al*., 1994) can be contaminated by faeces from pets (Mizgajska, 2001). Dogs and cats disseminate eggs of *Toxocara spp* in the environment and act as potential source of infection for

human (Luty, 2001), especially children, because of pica habit or through playing in soil contaminated with *Toxocara eggs* (Glickman and Schantz, 1981; Ruiz de Ybanez *et al.*, 2001).

The poor sanitary condition in developing countries such as Nigeria (Yusuf and Husseini, 1990; Motarjemi *et al*., 1993) accounts for the presence of parasitic immature stages in the soil (Mahdi and Ali, 1993).

The soil therefore contaminated with faecal material that may contain parasitic immature stages (Duniya, 2000) acts as an indicator of the potential risk of exposure of humans to *Toxocara* (Mizgajska, 2001).

Abuja Parks are patronized by a large number of people from all parts of the country, most of the time; people sit on the ground and may therefore be exposed to helminth eggs.

1.3 JUSTIFICATION

The WHO Global Burden of Disease Studies was drawn on a wide range of data sources to develop estimates of incidence, prevalence, severity, duration and mortality of diseases worldwide (Traub *et al*., 2004). This emphasizes the importance of surveillance program for zoonotic diseases such as *toxocariasis* that can be acquired through contact with pets or from contaminated soil and formites, as most pet owners in developing countries like Nigeria do not present their pets for adequate veterinary care. Likewise, people especially those from socio-economically disadvantaged communities are neither aware that they are at risk of contacting diseases from contaminated soil nor that living conditions such as

unhygienic practices can exacerbate the risk of disease transmission from the environment. Over 130 countries worldwide are reported to be endemic with soil transmitted helminthes (WHO, 2008).

In developed countries such as the United Kingdom, there is a strong human-animal relationship, such that pets have greatly received attention especially in terms of veterinary care (Traub *et al.*, 2004). Even with the special care given, there is still evidence of helminth contamination in developed countries like United Kingdom (Snow *et al.*, 1987)

In Nigeria and other developing countries where there is an uncontrolled population of stray dogs (Ogunkoya, 1997) and inadequate veterinary care, there is high likelihood of a high degree of soil contamination by geohelminth eggs. Though the prevalence of parasitic infections among school aged children have been found to be high (Suswam *et al.*, 1992; Mafiana, 1995; Arinola and Fawole, 1995), the awareness on the dangers posed by contaminated soil is still low (Maikai *et al.*, 2008). Thus, studying the extent of soil contamination in the ever increasing densities of human population within urban square such as Abuja, will aid in the evaluation of measures for the control of faecal contamination of parks and gardens.

1.4 OBJECTIVES

1) To determine the prevalence of geohelminth eggs in recreational parks and gardens in Abuja Metropolis.

2) To determine the influence of pH on the prevalence of geohelminth *eggs* in recreational parks in Abuja Metropolis.
3) To determine the influence of soil texture on the prevalence of geohelminth eggs in Abuja recreational parks.

1.5 HYPOTHESES FOR THE STUDY

The following null hypotheses were formulated to guide this study:

1) There is no significant association between the prevalence of geohelminth eggs and the study sites.
2) There is no significant association between the prevalence of geohelminth eggs and soil pH.
3) There is no significant association between the prevalence of geohelminth eggs and soil type.

CHAPTER 2

LITERATURE REVIEW

2.1 INTERNAL HELMINTH

The word “Helminth” was derived from the Greek word “helmins” (worm). Helminths are worm-like organisms that live and feed off living hosts (Maizels & Yazdanbaksh, 2003). Parasites that live in the digestive tract are called gastrointestinal parasites.

The intestinal helminth parasites that parasitize the domestic and wild animals and humans are categorized into 3 groups: Cestodes are of the Phylum Platyhelminthes and belong to the class Cestoda, trematodes belongs to the phylum Platyhelminthes and class Trematoda and Nematodes, which are members of the phylum plemethelminthes and class Nematoda.

Although the parasites that cause helminth infections are naturally present in the environment, high prevalence of intestinal infection is closely related to poverty, poor hygiene and lack of education (WHO 1997).

Worm eggs, larvae or even adults enter the human body through the mouth, anus, nose or skin. Human thus become infected by coming in contact with soil, water or food that contains the eggs or juveniles of these parasites (Soulsby, 1987; WHO, 1997).

Intestinal helminths affect the health and well being of millions of people especially children. WHO (1997) stated that about four hundred million school age children

are infected with different types of worms, with 130 countries endemic with the infection worldwide(WHO, 2008). Infection with helminths can cause abdominal pain, diarrhea, anemia, ulcers and various other health problems. They also destroy tissues and organs in which they live. Long-standing and chronic infection can result in death (Soulsby, 1986; WHO, 1997).

Clinical signs of helminth infection in animals are variable and occasionally some infected animals may be asymptomatic. However severe clinical cases in young dogs especially lead to diarrhea, anemia and death (Ramirez-Barrios *et al.*, 2004). Different techniques may be used for parasitic diagnosis, but the most common is faecal floatation method (Ramirez-Barrios *et al*., 2004).

2.2 COMMON EXAMPLES OF INTESTINAL HELMINTHS (GEOHELMINTHS)

In the screening of the soil samples by different researchers from different environments, the following geohelminths are the most encountered: *Toxocara species, Teaniid* eggs, *Ancylostoma species, Duipylidium. caninum, Trichuris* and *Ascaris* (Labarthe *et al*., 2004; Mizgajska, 2001; Ruiz de Ybanez *et al*, 2001; Sanches *et al* 2003).

i) Taenia species

Members of the phylum Platyhelminthes, and class Cestoda, are often referred to as cestodes or "tapeworm." The cestodes possess many basic structural characteristics of flukes, but also show striking differences. Whereas flukes are flattened and generally leaf-shaped, adult tape worm are flattened,

elongated and consist of segments called proglottids. Tapeworm varies in length of 2-3 mm to 10mm and may have three to several thousand segments.

Anatomically, cestodes are divided into a scolex, or head, which bears the organs of attachment, a neck that is the region of segment proliferation, and a chain of proglottids called the strobila, which elongates as new proglottids form in the neck region. The segments nearest the neck are immature (sex organs not fully developed) and those more posterior are matured while the terminal segments are gravid, with the egg-filled uterus as the most prominent feature. A characteristics feature of the adult tapeworm is the absence of an alimentary canal; substances enter the tapeworm through tegument. The tapeworm however differs from flukes in the mechanism of egg deposition. Eggs in the tapeworm exits through the uterine pore in the center of the ventral surface, rather than through the genital atrium as in flukes.

Larval forms, which are cystic or solid, inhabit the extra intestinal tissues. Tapeworm infection is the most common helminth infection in humans with both man and animals acting as definitive or intermediate hosts (Soulsby, 1986). About seven species of *Taenia* are found in the domestic dog, which may infect it singly or in multitudes. It includes: *Taenia hydatigena, T. pisiformis, T. granulosus, T. serialis, T. multiceps, T. ovis* and *T. multicularis.* The most common adult tape worms of man are *T. saginata* or *T. solium* (Soulsby, 1987; Smyth, 1994). *T. saginata* is cosmopolitan most especially where hygiene may be poor and or raw or insufficiently cooked meat is consumed (Symth, 1994). In Latin America, it is estimated that 75 million

people live in endemic areas and 400,000 people have symptomatic disease (Bern *et al*., 1999). Some studies suggest that the prevalence in Mexico is 3.1 and 3.9 with seroprevalence in areas like Guatemala, Bolivia and Peru as high as 20% in humans and 37% in pigs.

The common route of infection in man is by ingestion of eggs or larvae of T. *solium,* but auto infection where man can be an intermediate hosts is another route of infection (WHO, 2009). This means that humans can be infected by larval cestodes that have developed from eggs produced by another being and develop cystercerci in their tissue. Cystercercosis or neurocystercercosis is the most common parasitic infection of the central nervous system of man (Garcia *et al.*, 2002).

Clinical signs of *Teania* infection includes: Increased appetite, headache and abdominal pains. Diagnosis of cestodes infection in man is by isolation of eggs in feaces, though the presence of eggs or proglottids in feaces does not necessarily means the infection with cysticercus, patients should be evaluated since auto infection can result via fecal-oral route. Immunoblot test can also be used where cysticercus specific antibodies react with structural glycoprotein from the larval cyst of *T. solium.*

Diagnosis can also be through neuroimaging using Computerized topography (CT) scan or Magnetic resonance imaging (MRI). The eggs of *Taenia* ranges from spherical like that of *Taenia solium* to oval like in *T. saginata* varying in sizes. The egg is surrounded by an outer envelope and capsule. To the inside

of this is an inner envelop which develops into the embryosphore, which gives the egg its characteristic brown radiant appearance (Charles and Robinson, 2006).

The eggs of *Taenia* specie vary from spherical like that of *Taenia solium (T. solium)* to oval like *T. saginata.* The egg is covered with an outer envelope and capsule which is lost in faeces. The inner envelope which develops into the embryosphore is made of blocks. This gives the egg the characteristic brown appearance.

The egg of *Taenia* has a similar appearance with the egg of *Echinococcus* thus making it difficult to differentiate the two.

ii) *Trichuris species*

This is also known as "whip worm". Two species of particular interest are *Trichuris vulpis* and *T. trichiura* the later being a common parasite of humans reported to infect up to 800 million people (Cooper and Bundy, 1988). Most *Trichuris* infections are probably asymptomatic, but in long time infection, heavy worm burdens can develop (Harold *et al*., 2000).

Infection with *Trichuris species* is confined mainly to the tropics specially Asia, and to a lesser degree Africa and South America.

Trichuris have a high degree of host specificity, even though canine whipworms have been recovered from humans on rare occasions (James *et al*, 2002).

Egg of *Trichuris* are lemon shaped, having bipolar plugs with thick shell (Smyth, 1994; Harrold *et al.*, 2000). Eggs are brownish in colour and contain unsegmented embryo when laid. They vary in sizes, with *Trichuris vulpis* measuring 70-89µm with an average of 75 µm (Georgi and Georgi, 1990).

iii) Dipylidium caninum (D. caninum)

This is the most common parasite of dog (Eguia-Aguilar *et al*., 2004), which may also occur in cats and foxes. It is double pored and often referred to as "cucumber tapeworm" because of the way the eggs cluster together resembling seeds of cucumber (Anonymous, 2007). D. caninum can be acquired from fleas (*Ctenocephalides canis, C. felis* and *Pulex irritans)* though this is rare. (Soulsby, 1986; Anonymous, 2007).

The adult cestodes reside in the intestine of dogs and cats rarely causing any serious disease. The clinical signs when present depend on the degree of infection, age, condition and breed of the host. Clinical signs may include malaise, colic, diarrhea, un-thriftiness, etcetera (Harold *et al.*, 2000).

Eggs of *D. caninum* are laid in capsules with each containing up to 30 eggs. A mature or gravid proglotid have a characteristics elongated oval shape, resembling cucumber seed (Soulsby, 1986). The eggs measure about 45 µm in diameter (Anonymous, 2007), but mobility of the proglotid may make the cucumber structure to disappear (Sanchez *et al*., 2003).

iv) *Ancylostoma species*

Hookworm is the most destructive helminth parasite of man, with estimated 900 million cases worldwide (Smyth, 1994). The worms occur in areas where sanitary and environmental conditions favour the development of eggs and larvae (Smyth, 1994). Although clinical cases of cutaneous larva migrans (CLM) appear to be uncommon, it may still be endemic in socio-economically disadvantaged communities such that may be found in developing countries like Nigeria. In Kaduna, Nigeria, a study conducted on the prevalence of helminth eggs in school play grounds, showed that ancylotoma spp accounted for 9% of the total helminthes detected (Maikai *et al.*, 2008). Infection with Ancylostoma is mostly seen in people that work bare footed (Traub *et al.*, 2004). Cutaneous contact with the infective stages of canine hookworm leads to cutaneous larval migrans (CLM) in human.

The eggs of hookworm are thin walled and elongated (Harrold *et al.*, 2000), with varying sizes. *Ancylostoma braziliense* is the largest measuring 75x45µm. *A. caninum* measures about 56-75 by 34-47µm and contains about eight cells when passed in faeces. *A. tubaeforme* measures 55-75µm x 43.4-44.7µm.

v) Toxocara species

Toxocariasis is an accidental human infection acquired by swallowing eggs of *Toxocara canis* or *T. cati*, the ascarid nematodes commonly found worldwide in dogs and cats. Children are at the highest risk of infection

because of pica, geophagia and playing in soils contaminated with animal faeces (Uga and Kataoka, 1995).

Because of the occurrence of both trans-placental and trans-mammary transmission of *T. canis,* puppies are usually born with or acquire ascarid infections early in life (Burke and Roberson, 1985). Kittens do not become infected in-utero, but like puppies, can acquire ascarids (*T. cati)* through the queen's milk (Swerzcek *et al.*, 1971). The tissue-migrating and early intestinal stages of these worms may cause severe, sometimes life-threatening disease in the first few weeks of life. Patent intestinal infections can develop within the first 2½ – 3 weeks of life.

A single female ascarid can produce more than 100,000 eggs/day resulting in the spread of millions of potentially infective ascarid eggs per day, throughout the area the puppy is allowed to roam (Kazacos, 2000). Once the eggs become infective, they can remain infective in the environment for years (Bowman, 1999).

There are four mode of infection of the disease in animals. The most basic (seen in puppies up to 3 months) is through the ingestion of *T. canis* eggs containing the L_2 (second larval developmental stage) from the environment. In the canine host, the larvae emerge in the intestine and burrow through the epithelial wall to migrate to the lungs, as is the case with other ascarid parasites in general (Schacher 1957; Sprent 1958). From the lungs, L2 molts into L3 climb the trachea, enter the oesophagus and

return to the intestinal tract to mature as adult worms. By the sixth month of ages in a puppy, this development ceases at L2. Instead of molting into L3, the L2 travels to a wide range of organs such as muscle, liver, brain, eye as well as gastrointestinal wall.

Another mode of infection is the trans-placental route, when during pregnancy L2 become mobilized three weeks to parturition and migrate to the lungs of the foetus where it molts to L3 just before birth. L3 then migrate in the newborn to the trachea, gets swallowed and mature to adult form in the intestinal wall within the sixth month of whelping.

A certain amount of the bitches' dormant larvae may penetrate the intestinal wall, get into the intestinal lumen and molt into adulthood again where more eggs (LI) may be produced. The puppy may again be infected through suckling of milk infected with L3 (Urghart *et al.*, 1996) and the cycle continues.

When mice or human ingest the eggs L2 from the environment, emerging larvae migrate to muscle and neurological tissues, where they can remain for many years in an arrested state without growth, differentiation or reproduction. Dormant tissue larvae can re-enter the transmission cycle when eaten by a canine predator and the larvae emerges in its intestine and burrow through the epithelial wall to migrate to the lungs and the cycle continues. In human, migrating larvae can invade visceral tissues, causing eosinophilia and non pathogenic malaise. Where larvae migrate to the eye,

it causes a condition referred to as ocular larva migrans (Woodruff 1972; Schantz, 1989). There is also evidence of central nervous system invasion (Magnaval *et al.*, 1997).

The eggs of *Toxocara* are subglobular, having thick finely pitted shells and varying in sizes. *Toxocara canis* egg measures 90x75m, *T. cati* 65x75m and *T. vitulorum* 75-95x60-75m (Soulsby, 1989; Smith, 1994). The eggs of the two species *T. canis* and *T. cati* are difficult to differentiate (Ruiz de Ybaneze *et al*., 2001).

2.3 FACTORS AFFECTING THE RATE OF DETECTION OF HELMINTH EGGS IN THE ENVIRONMENT

Faecal pollution (Wong *et al*., 1994), contact with animals (Minvsielle *et al.*, 1993), poor hygienic practices (Mason and Patterson, 1994) and improper disposal of waste (Oberg *et al.*, 1993) are some of the factors recognized to promote spread of helminth infection most especially in developing countries where the economy is poor. Factors such as climate and vegetation as well as sampling and laboratory procedures also influence the results of soil contamination.

Selection of the sampling sites, number and quantity of samples collected, depth of sample collection, season of sample collection, method of egg recovery, and type of soil examined, preservation and expertise in analysis can all affect the result of soil contamination (Mizgajska, 2001).

i) Climatic factors

Geographically, parasites will be found in climates where humidity and temperatures conditions are appropriate for parasitic development (Ramirez-Barrios *et al*., 2004). In most studies, comparing soil samples collected at different seasons of the year yielded different findings (Mizgajska, 2001). The viability of eggs is also shown to be lower in dry-hot season than other seasons of the year (Ruiz de Ybanez *et al*., 2001). Humid soils favour the long survival of *Toxocara*eggs in soil (O'Lorcain, 1994). Ancylostoma eggs require warm temperature and high humidity (Ponce-Macotela *et al*., 2005). Ascarid eggs are found to survive better in moist shaded areas (Childs, 1985). Eggs have been found to survive at a temperature of -27^{o}C under snow but it has been shown that rapid freezing to -40^{o}C destroys it. Eggs exposed to sunlight get destroyed even at room temperatures (Mizgajska, 2001).

ii) Vegetation

Studies have shown that there is a significant difference in the rate of discovery of eggs from soil within areas that are moist and shady compared to open sunny areas without vegetation (Ruiz de Ybanez *et al*., 2001).

iii) Faecal material

Faecal contamination by both human (Duniya, 2000) and animal (Uga, 1993) is likely the major factor in soil contamination by helminth eggs.

iv) Environment

Deplorable environmental condition especially in developing countries such as Nigeria, accounts for the presence of different infective stages of parasite within the environment (Mahdi and Ali, 1993; Amodi, 2000).

v) Socio-economic status

Previous studies have shown a significant presence of helminth infection in socially disadvantaged areas such as Africa, Asia and South America (Traub *et al.*, 2004). In poor neighborhood, playing outside especially in the soil still remains a major way of entertainment for children thereby exposing them to risk of coming in contact with contaminated soil and infected dogs. In such areas, soil contamination is mechanical by infected dogs (Traub *et al.*, 2004*).*

vi) Sampling sites

Previous studies have shown that urban areas are more contaminated with helminth eggs than villages and samples collected from individual backyards and city centers are more infected (Mizgajska, 1995 and 1997). This may be due to insecurities in town as most people in developing countries keep dogs mostly for security purpose as watchdogs.

vii) Depth at which soil sample is collected

Irrespective of the depth used in taking soil samples, it has been shown that animal defecation is distributed evenly in soil (Uga *et al*, 1996) possibly by the activities of earthworms and small mammals (Fisher, 2003). Eggs of *Toxocara* has been found to be more when analyzing soil collected from sandpit surfaces than sand collected some centimeters deep. (Uga,1993).

viii) **Types of soil examined**

Mizgajska, (1997) reported that there is no direct relationship between soil texture (Percentage of gravel, sand clay, silt) and the prevalence of helminth eggs in soil even though physical properties of soil do influence survival of

eggs in the soil. Soil pH and exchangeable cations however affect the prevalence of helminth eggs in soil (Sam-Wobo and Mafiana, 2004).

2.4 PREVENTION AND CONTROL OF HELMINTH INFECTION

Interruption of the transmission cycle is the best way of preventing and controlling helminth infection. This may be achieved through public enlightenment, strict hygienic practices and administration of drugs to treat infected humans and animals. Fencing (Uga and Kataoka 1995) will also help in preventing stray dogs from accessing areas.

2.4.1 Public Enlightenment

Increasing public awareness on zoonotic diseases through media houses will play a significant role in enlightening people on the dangers posed by our pets if they are not properly cared for (Alonso *et al*., 2001). People that are socio-economically disadvantaged should be made to understand that owning a pet such as a dog is like adding an additional person in the house and should be discouraged from owning pets unless where adequate care and shelter can be provided. There should also be awareness on deworming and treatment of already infected humans and animals (WHO, 2006).

2.4.2 Strict Hygienic Practices

Strict hygiene as well as personal and environmental hygiene should be observed at all times particularly in children (WHO, 1997) to prevent infections. Wastes should be collected regularly and burnt or buried so that stray dogs are not attracted to the sites to search for food, and defecate and contaminate the sites.

2.4.3 Chemotherapy

Regular deworming of dogs and humans is an obvious way of controlling the spread of zoonotic helminth eggs. Drugs such as albendazole, ivermectin, levamisole, menbendazole and pyrantel have been shown to have 100% effectiveness in treating helminth infections in animals (Ottensen, 1990).

2.5 THE SITUATION IN NIGERIA

Toxocara has been found to be one of the most prevalent intestinal helminth within the Nigerian populace. Tekdek and Umoh, (1985) reported that *Ancylostoma caninum* and *Toxocara canis* are the two most common nematodes in dogs in Nigeria. *Toxocara* eggs were found to be 24.35% out of the 115 soil samples examined in Zaria (Galadima *et al*., 1981).

In an investigation carried out in Zaria, Kaduna State of Nigeria by Ajanusi and Gunya (1998), *Toxocara* eggs represented 17.5% of the total number of eggs seen in samples of dog feaces examined. In a ten year retrospective study on the effect of age, sex and season on the prevalence of *Ancylostoma* and *Toxocara* in dogs within Zaria, Ajanusi and Asiribo (2004) came up with the conclusion that *Toxocara* infection is the highest in puppies and that the number of dogs with single infection was higher than those with multiple infections. Also, male dogs were found to be more infected than the females. Of the 608 soil samples from 14 playgrounds that differ in socio economic status in Kaduna metropolis, Nigeria, 50.4% were reported to be positive for *Toxocara* eggs (Maikai *et al*., 2008).

CHAPTER 3

MATERIALS AND METHODS

3.1 EXPERIMENTAL SITES

The study was conducted in Abuja phase 1 which has five (5) districts namely; Abuja Central, Garki, Wuse, Maitama and Asokoro. The city that covers an area of 713km and according to the 2006 census has an estimated population of 778,567 people (http//www.fct.gov.ng\).

Abuja is characterized by three weather conditions annually. There is the rainy season which begins in April and ends in October with a temperature range of 28^{o}C to 30^{o}C at night. During the dry season periods temperature can be as high as 40^{o}C during the day and can drop to as low as 14^{o}Cat night during the harmattan period. The change in temperature can be attributed to the high altitude and undulating terrain of the territory. Between the rainy and dry period there is a brief period of harmattan with a common feature of dusty haze. Annual rain fall of the territory ranges between 1 100 millimeter to 1600 millimeter (htpp//dwww.fct.gov.ng\).

The Central Area is located between the foot of Aso Rock and the Three Arms Zone, to the southern base of the ring road. It is like the city's spinal cord, dividing it into the northern sector with Maitama and Wuse, and the southern sector with Garki and Asokoro. While each district has its own clearly demarcated commercial and residential sectors, the Central District is the city's principal Business Zone, where practically all parastatals and multinational corporations have their offices.
There are five officially approved parks in Maitama area, 12 in Wuse, eight in Garki, three in central area and none in Asokoro.

3.2 QUESTIONNAIRE

Prior to the collection of soil samples, a structured questionnaire was used to study some factors that may affect the prevalence of helminth eggs and to determine the awareness of risk of parasitic zoonoses. The questionnaire was designed to obtain information on the level of awareness of respondents on helminth infection, eating at parks and maintenance of hygiene. A total of 200 questionnaires were circulated to people that live around the park areas and people within the parks

3.3 SAMPLE SIZE DETERMINATION

The method used for determination of sample size in this survey was based on works of others where soil samples varied from 115 (Galadima *et al.,* 1989) to 680 (Maikai *et al., 2008)* in Nigeria and 44 in Malaysia to 698 in Spain (Ruiz de Ybanez *et al.,* 2001). Sample size was determined based on the sizes of the parks. The formula ($n= z^2pq/L^2$ where n=sample size, z=app value from the normal for the desired confidence, p=proportion of success, q=1-p proportion of failure and L= allowable error.) was not strictly adhered to in this study. The different sites were identified and numbered. There was balloting and sampling with replacement to select the required number of sites

3.4 SAMPLING PROCEDURE

Stratified random sampling was used for this study. There are three officially approved parks in the Central Area, 5 in Maitama, 8 in Garki, 12 in Wuse and none in Asokoro. Among these parks, twenty one were identified to be family friendly. The names of these parks were written on separate pieces of paper folded and the

folded pieces of paper were mixed then divided into five groups. From each group, parks were selected through balloting and sampling with replacement.

Samples were collected from seven parks: Parks A (Wuse 5), Park B (Maitama), Park C (Maitama), Park D (Wuse 6) Park E (Wuse 4), Park F (Central area), and Park G (Central area) (Appendix iv).

The different sites were identified and numbered. There was balloting and sampling with replacement to select the required number of sites.

3.5 SOIL SAMPLE COLLECTION

Soil sample collection in the park was carried at 5 meters interval for points 1, 2, 3, etc. A ruler was used to measure 3cm on the trowel from its tip, to aid in measuring depth for soil collection. With the aid of the trowel, 100g of soil samples were collected three cm deep into the soil and put into labeled polythene bags. Another 100g of soil was randomly collected from three points out of the selected areas (two extremes and the centre point), and put in three separate labeled polythene bags for soil analysis. All polythene bags collected from each location were then put into large black polythene bag and sealed. The sealed bags were then stored and kept in the refrigerator at $4^{o}C$ until examination.

Number of samples per site varied (48-240) according to size of the playgrounds as more samples were collected from larger parks. A total of 764 samples were collected from the seven selected parks with an average of 109 samples per park.

3.6 SAMPLE PROCESSING

In the laboratory, egg recovery was carried out using a modified version (Maikai *et al*., 2008) of the sieving method devised by Laborde *et al.*, (1980) and modified by Ruiz de Ybanez *et al*., (2000).

Fifty grams of soil was weighed out of each polythene bag. The weighed soil was then put into 250ml beaker, stirred with a glass rod and strained through three sieves with apertures of 1000µm, 850µm, and 400µm. The collected filtrate was then allowed to settle for 15 minutes after which the liquid was then decanted. The sediments were then collected in 30ml centrifuge tubes, shaken with 15ml sucrose (specific gravity of 1.25) floatation solution and centrifuged at 1500g for 5min.

The supernatant (15ml) was then poured into a dropper bottle, and this was used to fill two chambers of Mcmaster slides. The slides were allowed to settle for 5 minutes and then examined under a light microscope (x 10) for the presence of *Toxocara* eggs. Morphological characteristics of eggs as described by Soulsby, (1987) were used to identify the eggs. The eggs of *Toxocara* were sub-globular, having thick pitted shells.

3.7 IDENTIFICATION OF *TOXOCARA* EGGS

Morphological characteristics of the eggs (Soulsby, 1987) were used for their identification. Eggs were counted regardless of their viability. The volume of the McMaster well is 0.15 each. For the two wells total volume is 0.3ml. If the total eggs in the two wells were counted to be χ that means 0.3ml of the wells contain χ eggs. The total volume of supernatant collected is 15ml. If 0.3mls contain χ, then

15mls will contain χ eggs divided by 3 times 15 eggs (χ/3 x 15). So 50 (grams of soil) would be equal to χ divided by I multiplied by 1 divided by 3 multiplied by 150 multiplied by 1 divided by 50. χ will be 1 (χ/1 x 1/3 x 150 x 1/50 = 1). Therefore, the multiplication factor is 1.

3.8 ANALYSIS OF SOIL SAMPLES FOR pH AND TEXTURE

A total of 21 soil samples were taken to the soil science laboratory for pH and particle analysis. The pH and particulate nature of soil were determined as described by Page *et al.*, (1982).

3.8.1 pH ANALYSIS

Each soil sample was crushed into finer particles using mortar and pestle, and sieved through a 2mm sieve. Thereafter, 10g of the soil samples were then taken in duplicate, each into a 100ml plastic container. Water (25ml) was added to one of the containers, and 25ml of 0.01mol of calcium chloride was added to the other. Each sample was then stirred for a period of 30min using separate stirring rod. Standardization of the pH meter was done using pH 4, 7 and 9. The pH electrode was then introduced into each sample and the pH measured and recorded as acidic, alkaline or neutral.

3.8.2 Texture Analysis

50g of the soil sample was weighed into a container, to which 100ml of a dispersant (calgon, Sodium hexametaphosphate) was added and then shaken for 30 minutes in a reciprocating shaker. The content was then poured into a 1500ml measuring cylinder and tap water added to the 1000ml mark. A plunger was then used and the

content was stroked 5 times. The plunger was removed and a hydrometer dropped for 40 seconds before recording. After 2 hours, another reading was again taken and recorded (corrected reading). The 40 seconds readings were always higher than the 2hrs reading.

A blank (calgon and water without soil sample) was treated the same way and the reading taken at 40 seconds. Percentage clay was calculated by subtracting the blank reading from the corrected 2hrs reading of each sample, multiplied by 100 and dividing all by the weight of soil taken.

i.e. $\frac{\text{corrected 2hrs reading - blank x 100}}{\text{Wt of soil taken}}$

Silt is calculated by subtracting percentage clay from the 40 sec reading divided by the weight of soil taken.

Percentage silt = $\frac{\text{40sec reading - \% clay}}{\text{Wt of soil taken}}$

Percentage sand is calculated by subtracting percentage clay from 100 plus percentage silt.

Percentage sand = 100 - percentage clay + percentage silt.

Samples were then classified according to the USDA method of International system of textural classification (Page *et al*., 1982) into sand, silt and clay.

3.9 MEAN DENSITY OF *TOXOCARA* EGGS DETERMINATION

To obtain the mean density per m^2 for each park, the number of eggs detected in the park was divided by the total area sampled.

3.10 QUESTIONNAIRE ANALYSIS

Two hundred questionnaires were distributed to people within and around the recreational parks. Houses that are less than 500m away from the park were considered as close whereas those that were farther than 500m from the park were considered far. Hundred questionnaires were distributed to people resident around the parks and one hundred distributed to people (visitors) within the parks with 6-10 questionnaires per park. Issues raised included, sighting of dogs, presence of dog faecal material, presence of cleaning facilities, observing hygienic measures at the park, e.t.c.

Numerical values were assigned to the 200 copies of the questionnaire responses. The frequencies and percentages of responses under the different options were determined. Data were afterwards collected and collated into different strata (Fig 1-4).

3.11 DATA ANALYSIS

Analysis of data was carried out using the Statistical Package for Social Science (SPSS). Pearson and Mantel-Haenzel Chi-square test were used where appropriate to test for association between the prevalence of helminth eggs and the risk factors considered in the study. $P<0.05$ was defined as significant.

Using EPI INFO (Dean, 1994), odds ratios (OR) and 95% confidence intervals (CI) were calculated for dichotomous variables. OR values greater than unity denote an association and less than unity denote that the factor may have protective effect. Prevalence was estimated by dividing the number of positive samples by the total number of the samples.

CHAPTER 4

RESULTS

4.1 PREVALENCE OF HELMINTH EGGS IN SOIL OF ABUJA RECREATIONAL PARKS

The prevalence showed a high rate (67.5%) of detection of helminth eggs in the soil samples. The highest rate of detection of helminth eggs was observed in Park D (83.3%), followed by Park E (70.0%) all in Wuse Area while the lowest rate (46.7%) was observed for Park A (Table 4.1) in Maitama Area.

Toxocara eggs were the most frequent helminth eggs (52.0%) in the soil samples. Park G was most contaminated with *Toxocara* eggs (64.0%). Even Park A which was the least contaminated with *Toxocara* eggs had 6.7% detection rate (Table 4.2).

The frequencies of detection of *Taenia, Isospora* and *Trichuris* eggs were 15.2%, 7.1% and 2.6% respectively. *Trichuris* eggs detected were 8.3% in Park D, 5.0% in Park E (5.0%) and 2.2% in Park F. *Isospora* was detected in Parks A, D, F and G were 6.7%, 8.3%, 2.2% and 28.0% respectively.

Table 4.1: Number of samples positive with helminth eggs in soils of Abuja recreational parks

Park	No of Samples Examined	No Positive (%)	No Negative (%)
Park A	60	28(46.7%)	32(53.3%)
Park B	68	36(52.9%)	32(47.0%)
Park C	64	32(50.5%)	32(50.0%)
Park D	48	40(83.3%)	8(16.6%)
Park E	240	168(70.0%)	72(30.0%)
Park F	184	124(67.4%)	60(32.6%)
Park G	100	88(68.0%)	12(12.0%)
Total	**764**	**516(67.54)**	**248(32.50%)**

Table 4.2: Percentage count of helminth eggs isolated in soil samples of seven recreational parks in Abuja

Park N	**Toxocara (%)**	**Taenia (%)**	**Isosphora (%)**	**Trichuris(%)**
A 60	4 (6.67)	12 (20.0)	4 (6.7)	0 (0.0)
B 68	24 (35.5)	12 (17.5)	0 (0.0)	0 (0.0)
C 64	24 (37.5)	8 (12.5)	0 (0.0)	0 (0.0)
D 48	24 (50.0)	8 (16.7)	4 (8.3)	4 (8.3)
E 240	140 (58.3)	16 (6.7)	0 (0.0)	12 (5.0)
F 184	100 (54.3)	16 (8.7)	4 (2.2)	4 (2.2)
G 100	64 (64.0)	44 (44.0)	28 (28.0)	0 (0.0)
Total	**376 (52.3)**	**116 (15.2)**	**40 (5.2)**	**20 (2.6)**





Plate I: A Egg of *Taenia*

B Egg of *Taenia*

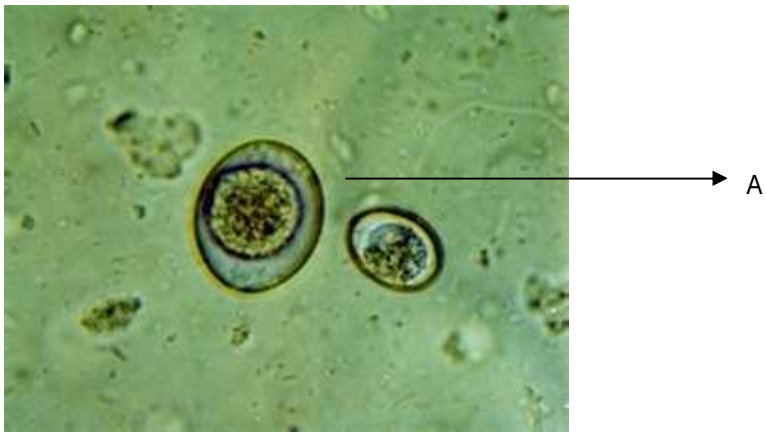
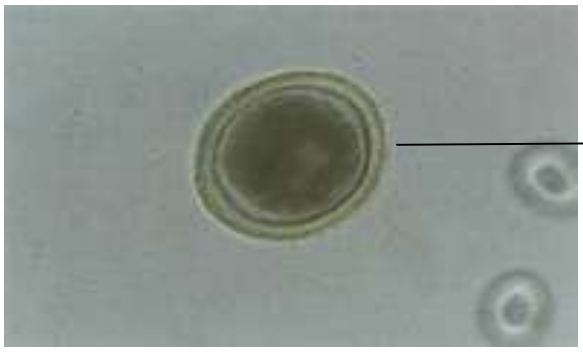




Plate II: A and B *Isosphora* oocyst



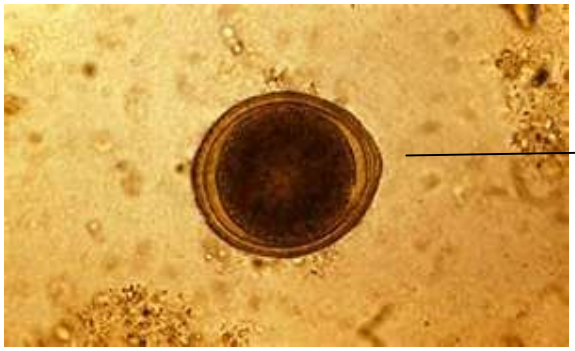


Plate III: A and B *Toxocara* Egg

Table 4.3: Mean of *Toxocara* eggs in soils of seven recreational parks in Abuja

Parks	**Samples**	**Positive**	**Total mean**
A	**60**	**28**	**6.7**
B	68	36	29.4
C	64	32	37.5
D	48	40	75.0
E	240	168	113.3
F	184	124	141.3
G	100	88	183.0
Total	**746**	**516**	

4.2 Soil Texture

Almost all soil types in all the parks are similar, variation between the parks is limited. The relationship between *Toxocara, Trychuris* and the soil texture is not very clear, but for *Isospora*and *taenia* it suggests that less sandy soil has low egg count.

The soil texture of Park D which happens to have the highest rate(83.3%) of detection of helminth eggs was found to be a mixture of two soil types (sand and clay) while Park A with the lowest helminth eggs detection (46.7%) was found to be a mixture of sand, clay and loam (Table 4.4).

The soil texture of Park G, which was the most contaminated with *Toxocara* eggs (64.0%), was found to be a mixture of two soil types (Sand and Clay). Park E was second highest (58.3%) with the same soil type (Sand and Clay), but Park F (54.3%) had a mixture of three soil types (Sand, Clay and Loam). Park A which was the least contaminated with *Toxocara* eggs (6.7%) also had a mixture of Sand, Clay and Loam (Table 4.4).

Table 4.5: Soil type for each of the seven recreational parks

Parks	Soil Type
A	Sandy, Clay, Loam (Mixed)
B	Sandy, Clay, Loam (Mixed)
C	Sandy, Clay (Mixed)
D	Sandy, Clay (Mixed)
E	Clay
F	Sandy, Clay, Loam (Mixed)
G	Sandy, Clay (Mixed)

Table 4.6: Mean of helminth egg load with respect to soil texture in seven recreational parks in Abuja

Parks	***Toxocara***	***Taenia***	***Isosphora***	***Trichuris***	**Soil Type**
A	6.7	22.5	7.5	0.0	Sandy, clay, loam
B	29.4	23.5	0.0	0.0	Sandy, clay, loam
C	37.5	12.5	0.0	0.0	Sandy, clay
D	75.0	16.7	8.3	6.3	Sandy, clay
E	113.3	6.3	0.0	4.6	Clay
F	141.3	8.7	2.2	2.2	Sandy, clay, loam
G	183.0	47.0	29.1	0.0	Sandy, clay
Total	**586.2**	**137.2**	**47.1**	**13.1**	-

4.3 Soil pH

Generally there is a downward slope (linear regression) for the three (*Toxocara, Teania* and *isospora)* out of the four helminth eggs isolated, which suggest that the more acidic the soil, the higher the egg load. However, the sample size is small and difference in pH is not large (6.9-7.1) Table 4.7.

Park D which happens to have the highest rate of detection of helminth eggs (83.3%) had a pH value of 6.9; Park E was second highest (70.0%) with pH of 7.1. The least rate of detection of helminth eggs was Park A (46.7%) also having a pH of 7.06.

Park G had the highest rate of detection of *Toxocara* eggs (64.0%) with pH of 6.96, followed by Park E (58.3%) with pH of 7.1. Parks F, D and C (54.3%, 50.0% and 37.5%) had pH values of 7.0, 6.9 and 7.1 respectively. Park A which had the lowest rate of detection of *Toxocara* eggs (6.7%) also had a pH of 7.06% (Table 4.7)
There was no significant association between the number of *Toxocara* eggs and pH of the soils of the recreational parks at $P<0.05$ (Table 4.7).

The prevalence of helminth eggs recorded in the soils of parks A,C and E which were slightly alkaline (pH 7.1) were 46.7%, 50.5% and 70.0% respectively, while the prevalence of helminth eggs recorded in parks B and D with slightly acidic soil (pH 6.9) were 52.9% and 83.3% respectively.

Table 4.7: Relationship between pH value and worm egg burden of the seven recreational parks in Abuja

Parks	***Toxocara***	***Taenia***	***Isosphora***	***Trichuris***	**Soil pH**
A	6.7	22.5	7.5	0.0	7.06
B	29.4	23.5	0.0	0.0	6.90
C	37.5	12.5	0.0	0.0	7.10
D	75.0	16.7	8.3	6.3	6.93
E	113.3	6.3	0.0	4.6	7.13
F	141.3	8.7	2.2	2.2	7.00
G	183.0	47.0	29.1	0.0	6.96
Total	**586.2**	**137.2**	**47.1**	**13.1**	-

4.4 Questionnaire Analysis

One hundred and ninety four questionnaires were returned from people within and outside the parks representing 97%. Fifty-seven (29.38%) live very close (0-10m) to the parks and 102 (52.58%) live far away (over 2m) from the parks. Thirty two (16.49%) live at the outskirt of town and 3 (1.60%) live outside Abuja.

Out of the 194 respondents, 66 (34.02%) owned dogs while 122 (62.89%) said they don't and 6 (3.09%) did not respond. Out of the 66 that own dogs, 16 (24.69%) allowed their dogs to roam the streets (Table 4.7).

Out 66 respondents that owned dogs, 36(55.38%) access medical treatment, while 28 (43.62%) never did and two did not respond (Table 4.8). Out of the 36 (56.38%) that accessed medical care, 10 (27.35%) said they treat their dogs only once a year, seven (18.86%) had them treated twice a year, 6 (16.98%) thrice a year and 13 (36.79%) quarterly (fig. 4.3).

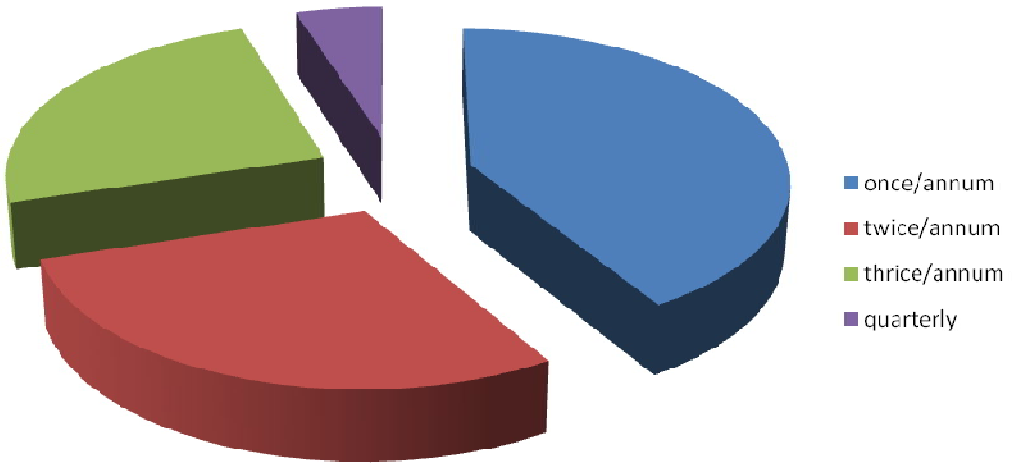


Fig. 4.1: Response to annual treatment of dogs

Out of the 119 (64.89%) that did not own dogs, 49 (41.18%) gave stress of maintaining them as reason for not owing dogs and 70 (58.82%) said they did not like dogs.

Out of the 194 respondents, 53 (27.32%) often went to the parks to exercise, 92 (47.42%) to relax, 27 (13.92%) for picnics, 6 (3.09%) on celebration days only, 7 (3.61%) to work, and 9 (4.64%) did not respond (fig. 4.4).

One hundred and forty eight (76.29%) out of the 194 respondents said they eat at the parks and 36 (18.56%) said they do not and 10 (5.15%) did not respond

Out of the 97 that had cause to come in contact with soil in the parks, 76 (78.35%) said they get in contact with soil by sitting on the ground, seven (7.22%) by playing with sand, 3 (3.09%) when they help children in the parks, 7 (7.22%) when they clean dust from their clothes after getting up from the ground and 4 (4.12%) when they put shoes on.

Thirty four (17.53%) of the 194 respondent said they take water along with them for cleaning. Thirty seven (19.07%) used the taps at the park to clean up and 112 (57.73%) said they only clean up when they get back home, while 11 (5.7%) did not respond (fig. 4.1).

One hundred and six (57.61%) said they thought parks in Abuja had sufficient provision for cleaning up and 78 (42.39%) did not think so.

One hundred and eighty four (94.85%) of the respondents had knowledge about helminth infection, while 10 (5.15%) did not respond.

Seventy (36.08%) of the respondents had awareness of human zoonotic diseases that can be acquired through soil contamination with faeces.

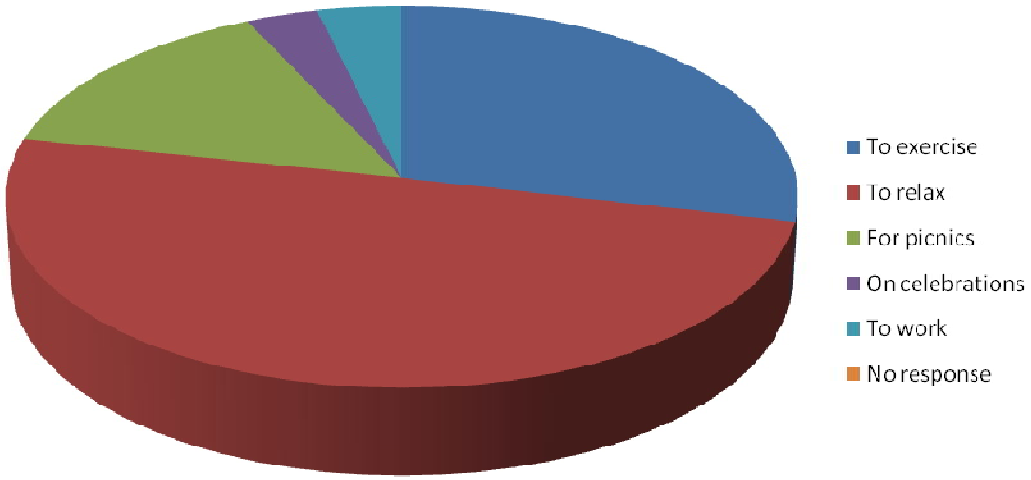


Fig. 4.1: Response to purpose of going to parks

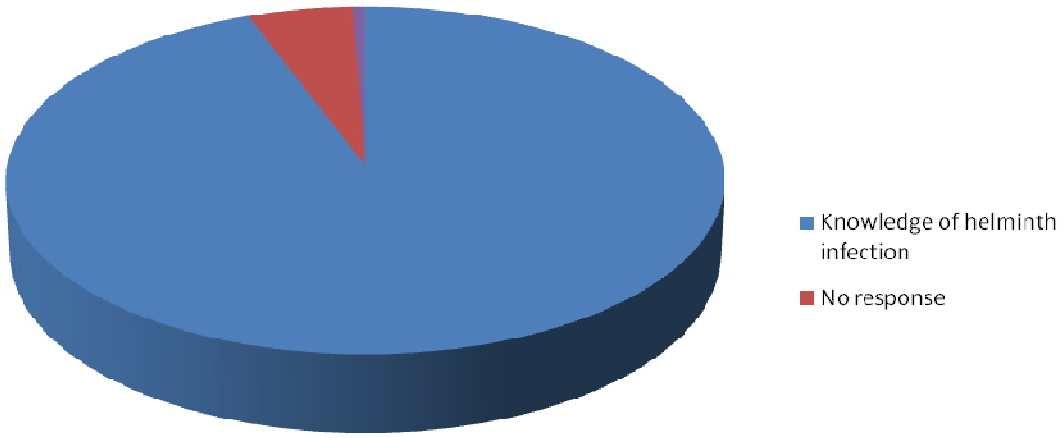


Fig. 4.2: Response to knowledge of helminth infection



Fig 4.3: Response to knowledge of Toxocariasis

CHAPTER 5

DISCUSSION

The 68.1% soil contamination rate with helminth eggs in this study is high; this could be due to the higher number of people that frequently visit these parks since it is known that eggs can be picked by sole of shoes and the chances of stray dogs going into the parks. Although more soil samples were collected from Park E, they were less contaminated than those collected from Park G. This may be because of the difference in vegetation. A study had shown there is a significant difference in the rate of discovery of eggs from soil within areas that are moist and shady compared to open sunny areas with no vegetation (Ruiz de Ybanez et al., 2001).The high rate of detection of *Toxocara* eggs recorded in this study is in agreement with the work of Maikai *et al*., (2008) where *Toxocara* eggs were found to be the highest of helminth eggs isolated from playgrounds in schools in Kaduna, Nigeria. The fact that these parks are frequented by all sorts of people from different works of life may have contributed to the high number of helminth contamination since soles of shoes also contribute to the distribution of helminth eggs in soil Mizgajska, (1997). According to Wong *et al.*, (1994), the principal source of parasitic infection in man is faecal contamination of soil. Contamination of the soil may be in form of manure used as organic fertilizer by gardeners. Faecal material can also be washed by rain from an infected area to a non-infected area. The report of Alonso *et al*., (2001) indicated that there is association between presence of faecal material and detection of helminth eggs.

Although Uga and Kataoka, (1995) proposed fencing as a way of reducing contamination of sandpits, eggs of helminth were detected from samples collected from most recreational parks in Abuja which are fenced. Contamination may be due to contaminated sole of shoes, manure that is used as fertilizer or helminths washed from other areas into the parks.

Toxocara has high productive rate and is extremely resistant to adverse environmental conditions which may contribute to their survival and accumulation in soil (Mizgajska, 2001).

Park E had the highest positive sample, contributing 70.0% of the total (764) samples from all the parks. This may be because the park is located in a highly populated area. There is a likelihood that dogs population is high where human population is high this is due to the fact that dogs are kept as pets and even if they are not allowed in parks there is a likelihood that people can carry dog feaces on their shoe soles (Mizgajska, 2001). The finding in this study is in agreement with the work of Yusuf and Hussaeini, (1990).

Toxocara eggs (52.1%) were the most frequent helminth eggs in all the soil samples. Other helminth eggs isolated during this work includes *Taenia* (15.2%), *Isospora* (7.1%) and *Trichuris* (2.6%) (Table 4.3). The presence of high rate of *Taenia* may be because dogs have access to bladder worms from infected offal serving as definitive host to disseminate the eggs (Soulsby, 1986). The low rate of detection of *Trichuris* in this study has also been seen in works of Maikai et al., (2008), which may be because of the environmental condition that does not favor their detection. *Trichuris* eggs require high humidity and access to oxygen for embryonation.

The fact that a significant percentage of respondents (61.2%) are unaware that diseases in dogs can be transmitted to man through soil is suggestive of the high level unawareness about parasitic zoonoses. This may result in ignoring basic hygienic practices resulting in infection.

In this study, a high percentage of respondents (60.0%) reported that they do not wash their hands until they returned home from visiting parks. This is an indication of high level of unawareness of the respondents to hygiene and this could pose public health risks to such beneficiaries of the parks.

Parks A, B, and F with 0.5%, 2.5% and 35.5% positive samples for *Toxocara* eggs respectively have a mixture of all three soil types (Sand, Loam and Clay), Parks C, D and G with 3.0%, 4.5% and 22.9% positive samples for *Toxocara* eggs have a mixture of sand and clay, while Park E with 43.0% of the soil samples positive for *Toxocara* eggs is more of clay than any other soil type. This indicated that no park had a distinct soil type and as such it may be difficult to associate soil type as a risk factor in the maintenance and spread of helminth eggs in this study. However, results of other studies Mizgaska, (1997) showed that there is no direct relationship between soil texture (percentage gravel, sand, clay, silt) and prevalence of helminth eggs in soil.

CONCLUSION, RECOMMENDATION AND LIMITATIONS

5.1 Conclusion

This study has shown that there is high level of contamination of soil of Abuja recreational parks and gardens with *Toxocara* and other helminth eggs and that screening of soil samples can be used as a strategy to determine the extent of contamination of soil with helminth eggs. The pH of soils of Abuja recreational parks and gardens did not affect the prevalence of *Toxocara* significantly.

Toxocara eggs were isolated from all the parks and all the parks had clay in their soil types. Even though knowledge of infection with helminth is high in this study, there is need to remind the general public on the dangers of infection with helminth.

5.2 Recommendation

The work has shown the need to improve on environmental hygiene of recreational parks and personal hygiene of the beneficiaries of the parks in view of the high records of helminth eggs reported in them and the public health implications.

There is still insufficient information on the relationship between the prevalence of helminth eggs and soil types as portrayed in this study, it is important that a further study on the role of soil type and of helminth eggs be carried out.

i) Recreational parks should be fenced so as to limit accessibility to stray animals.

ii) Pubic enlightenment should be carried out in media houses to show the dangers posed by contaminated soil and remind the public on the importance of hand washing.

iii) Pet owners should ensure that pets are regularly de-wormed to prevent the dissemination of helminth eggs in the environment.

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Appendix 1

a) Maitama: Sites B and C

b) Wuse: Sites A, D and E

c) Garki: Sites D and

d) Asokoro: Sites Nil

e) Central area: Sites F and G

Sample Sites

Sites	Park size (m^2/hectare)
A. (Cascade Park)	2.3
B. (Selini Park)	0.6
C. (Mabushi)	0.5
D. (Berger)	0.4
E. (Wuse)	0.36
F. (Unity)	2.0
G. (Millennium)	3.1

Appendix II

Preparation of flotation media

Sucrose specific gravity 1.25

Dried granulated Sucrose: 1300

Dried granulated Sodium Chloride (NaCI): 480g

Boiled water: 2 liters

Glass Rod

Metthod:

The 2 liters of Boiled water was shared into two parts of 1 liter. Sucrose and sodium chlorid were dissolved separately before mixing. The glass rod was used in stirring the two mixtures. The specific gravity was measured to ascertain the correct gravity and then poured into a labeled Manchester bottle.

NaCI specific gravity 1.20

Dried granulated Sucrose: 700g

Dried granulated NaCI: 400g

Boiled Water 2 liters

Glass Rod

Method

Same as that of Sucrose

Appendix III

Determination of multiplication factor

Total volume of Me Master well = 0.15 x 2 = 0.3ml

If total eggs in the 2 wells = X

That means 0.3ml contained X eggs

Total volume into which eggs were washed = 15ml

If 0.3ml = X eggs

Therefore 15ml = X/3 x 15 eggs = X/3 x 15

So 50g of soil = X/1 x 1/3 x 130 x 1/50

X = 1

Therefore the multiplication factor is 1

Appendix IV

QUESTIONNAIRE SURVEY OF PARK/GARDENS IN ABUJA MUNICIPAL AREA COUNCIL

1. Sex: (a) Male (b) Female

2. Age: (a) Under 20
   (b) 21 – 40
   (c) 41 – 60
   (d) Over 60

3. Where do you reside?
   ---------- which is:

   (a) Close to a park area
   (b) Far from a park area
   (c) Walking distance from a park
   (d) Outskirt of town.

4. Educational background:

   (a) Primary School Certificate
   (b) Secondary School Certificate
   (c) Tertiary Certificate
   (d) Others (Specitya0:----------

5. Marital status:
   (a) Single
   (b) Married
   (c) Divorced
   (d) Widowed
   (e) Separated

6. Number of Children:
   (a) None
   (b) Less than 3
   (c) 4-7
   (d) Over 7

7. Do you own a dog or cat:
   (a) Yes
   (b) No

8. Do you allow your pets to roam around your area

   (a) Yes
   (b) No

9. Do you treat your dog/cat against worms?
   (a) Yes
   (b) No

10. How often do you treat them against worms in a year?
   (a) Once a year
   (b) Twice a year
   (c) Thrice a year
   (d) Quarterly

11. Which of the gardens in Abuja do you often visit?
   (a) Millennium Part
   (b) Natural Park and Zoo
   (c) Cascade Park
   (d) Seleni Park
   (e) Wuse Market Park
   (f) Unity Park
   (g) Others (Specify)----------

12. How often do you visit parks?
   (a) Daily
   (b) Once a week
   (c) Once a month
   (d) Occasionally
   (e) Once a year
   (f) Not at all

13. When you visit do you go:
   (a) Alone
   (b) With Children
   (c) With other members of the house hold
   (d) With your Pet (Dog)
   (e) With your Pet and Children

14. What normally takes you to the park?
   (a) To exercise
   (b) To relax
   (c) On Picnic
   (d) To celebrate occasions
   (e) To work

15. How do you clean up at the park before and after eating?
   (a) I take water along
   (b) I use taps at the part

(c) I clean up when I get back home

16. Have you ever had course to come in contact with the soil at the park
    (a) Yes
    (b) No

17. If yes, how did you come in contact with the soil?
    (a) I/we sit on the grass
    (b) I help children play with sand at the park
    (c) I like playing with sand at the park
    (d) I clean/dust children when they fall at the part
    (e) I help the children put their shoes on when we are to leave the park.

18. When you take children along, do you all get to eat at the park?
    (a) Yes
    (b) No

19. Do you think parks in Abuja have sufficient provision for cleaning up?
    (a) Yes
    (b) No

20. Have you ever heard of Helminthiasis?
    (a) Yes
    (b) No

21. Have you ever heard of helminth *Toxocara*?
    (a) Yes
    (b) No

22. Are you aware there are diseases from dogs that can be passed unto man through soul?
    (a) Yes
    (b) No

23. Do you know that children under the age of 6 are at greater risk of contacting such diseases because of their eating habits and mode of play?
    (a) Yes
    (b) No

Section B (To be filled by the researcher based on observation)

24. Is the site fenced?
    (a) Yes
    (b) No

25. Any dog seen at site?
    (a) Yes
    (b) No

26. Any dog feaces seen per square meter?
    (a) Yes
    (b) No

27. Number of feaces seen per square meter ----------

28. Topography of site:
    (a) Gentle slope
    (b) Irregular slope
    (c) Flat slope

29. Type of vegetation where sample is collected:
    (a) Grassy
    (b) Bare

30. Soil Characteristic:
    (a) Wet Moist)
    (b) Dry (powdery)

31. Season of the year:
    (a) Rainy season
    (b) Dry season