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## PREVALENCE OF *TAENIA* EGGS IN SOILS OF RECREATIONAL PARKS OF ABUJA CENTRAL AREA, NIGERIA

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### Abstract

Soil contaminated with *Taenia* eggs can cause health-related problems, mostly to people who come in contact with such soil. The presence of parasitic forms within urban squares and public recreation areas is of a significant health risk. This research work studied 184 soil samples from 16 selected recreational parks in Abuja to ascertain the prevalence, of *Taenia* eggs using zinc sulphate flotation medium with a specific gravity of 1.25. Of the 16 recreational parks randomly selected out of the 20 recreational parks in the central area, *Taenia* egg were found in 15 parks. Out of the 184 soil samples examined, 49 samples were contaminated with *Taenia* eggs. A total of 12290 *Taenia* eggs were found in the 49 soil samples. Millennium Park had the highest *Taenia* eggs count of 3640 (29.62%) followed by Jabi Lake Park with 2020 (16.44%) *Taenia* eggs, then Orbit Garden with 1800 (14.65%) *Taenia* eggs and Wuse Market Park with 1200 (9.93%) *Taenia* eggs. The other 11 recreational parks had *Taenia* eggs count of less than 900 each. Based on this, it is recommended that public awareness on appropriate hygiene practices should be practiced while ensuring the presence of sufficient sanitary facilities and enforcing land use regulations.

### Introduction

The cestode parasites of major economic and public health importance are members of the family Taeniidae, genera *Taenia* and *Echinococcus*. These parasites all have indirect life cycles involving a carnivorous or omnivorous definitive host, in which the adult stage develops in the small intestine and an intermediate host in which the larval (metacestode) form develops in the host tissues (Lightowers, 1990). Taeniasis is an accidental human infection acquired by the ingestion of raw beef/pork containing an intermediate form (*Cysticercus*) of *Taeniasaginata* and *T.solium*- respectively. Humans are the final hosts, for *T. solium*. In *T.solium* however, humans can also be the intermediate hosts. In addition, the larval stage of other *Taenia* species (e.g., *T.multiceps*, *T.serialis*, *T.brauni*, *T.taeniaeformis*, *T.crassiceps*) can infect humans in various sites of localization including the brain, subcutaneous tissue, eye, or liver (CDC, 2007).

Auto infection is another route of infection for *T.solium*. Gravid proglottids are carried to the stomach by reverse peristalsis where the onchosphere become liberated and develops into the cysticercus. (WHO, 2009). This means that humans can become infected with eggs spread by other humans and develop cysticerci in their tissue. When humans ingest eggs, metacestodes develop within the muscle, under the skin, in the intestine, brain and spinal cord. The human to human transmission of disease results in most clinically serious forms of the disease. This is through direct contact with human faeces and develops cysticercus in their tissues resulting in cysticercosis (metacestode within tissue) which can lead to pain at site of the cysts, swellings, fibrosis granulomas and calcification. When the cysticerci are located within nervous tissue, patients can experience paralysis and seizures that can be fatal (Merle and Nicole, 2000; Hector and Manish, 2008).

The great majority of *T. saginata* and *T. solium* carriers are unaware of their infection. However, carriers of *T. solium* carry a substantial risk of acquiring cysticercosis by faeco-oral autoinfection and members of their households are also at risk (WHO, 2009). The eggs from these cestodes are common environmental contaminants of human habitation, due largely to the environmental control and sanitation which constitutes a significant factor in the spread of the disease.

Humans, particularly children are at the highest risk of infection because of pica, geophagia, and playing on soils contaminated with human faeces (Uga and Kataoka, 1995). This is particularly true of *T. solium* infection where human infection can occur via the ingestion of eggs from contaminated soil. Dada (1980), obtained prevalence rates of 0.9%, 0.6% and 0.6% respectively for *Taenia* infection for 3 ecological zones of Nigeria from a retrospective study of hospital records.

Contaminated shoes (Nock and Tanko, 2000; Luty, 2001) act as potential sources of infection for humans especially children because of pica habit or playing in soil contaminated with *Taenia* eggs (Glickman and Schantz, 1981; Ruiz de Ybanez *et al.*, 2001). Global warming has also created an environment that facilitates the rapid and widespread dissemination of water, soil and foodborne zoonotic pathogens (Gajadhari *et al.*, 2006). The lack of sanitary facilities such as toilets or the enforcement of environmental sanitation regulations may increase the risk of infection. Both forms of taeniasis usually have a minor impact on human health; taeniasis due to *T. solium*, however, is of significant public health importance as it plays a crucial role in the transmission of cysticercosis, a serious disease.

Neurocysticercosis is considered to be a common infection of the human nervous system and is the most frequent preventable cause of epilepsy in the developing world. More than 80% of the world's 50 million people who are affected by epilepsy live in developing countries, many of which are endemic for *T. solium* infections in people and Cysticercosis mainly affects the health and livelihoods of subsistence farmers in developing countries of Africa, Asia and Latin America. Infection can lead to epilepsy and death in humans, reduces the market value of pigs and cattle and makes pork and beef unsafe to eat (WHO, 2009). The poor sanitary condition in developing countries such as Nigeria (Motarjemi *et al.*, 1993) accounts for the presence of parasitic immature stages in the soil (Mahdi and Ali, 1993), and air (Lawande, 1983). The soil is therefore contaminated with human faecal material that may contain eggs of *Taenia* with the contaminated soil acting as an indicator of the potential risk of exposure of humans to *Taenia*. (WHO, 2009)

*Taeniasolium* cysticercosis remains a major public health problem in many developing countries of Latin America, Africa and Asia especially with the established increase in consumption of pork in Nigeria (Adebisi, 2008). Public awareness of sources of contamination and infection by helminths is poor. Inadequacy of sanitary facilities in public parks persists and poor sanitary habits of the public constitute a problem. Studying the extent of soil contamination in urban centers such as Abuja that has high human population density will aid in the determination of the presence of *Taenia* eggs in soil, Public health implication as well as device control measures against contamination of recreational parks by stray dogs.

## Materials and Method

### Sampling sites

Out of the 20 parks located in the Central Area of Abuja, 16 were randomly selected for sample collection. In order to get the most accurate locations of the parks within Abuja, Android phone was used to get the Geocodes of each park. The parks were then mapped using Arch-Info software to produce a map showing their locations on an administrative map of Abuja. Five long strides of the researcher were used to measure approximately 25m<sup>2</sup> of an area. At every 2m<sup>2</sup>, a

mark was made and a number placed. To collect a sample, the marked site was dug to a depth of about 3 cm using a hand trowel, after which about 100g of soil was collected. The collected samples were then stored in sealed labeled polythene bags and kept in the dark until examination as described by Maikaiet *al.* (2008).

### Sample Processing

Collected samples were taken for pH and texture analyse in the Soil Science Laboratory of the Institute for Agricultural Research (IAR) of Ahmadu Bello University, Zaria using the method described by Page *et al.*, 1982. In the laboratory, egg recovery was carried out as described by Maikaiet *al.*, 2008, which is a modified version of the sieving method devised by Ruiz de Ybanezet *al* (2000). Briefly, 50g of soil was weighed, mixed in a plastic container and washed with running tap water into 250ml beaker, using three sieves with mesh diameters 100 $\mu$ m, 400 $\mu$ m and 850 $\mu$ m,. The filtrate was allowed to settle for 15min and the liquid decanted. The sediment was collected in 30ml centrifuge tubes, shaken with 15ml Zinc Sulphate (specific gravity of 1.25) floatation solution and centrifuged at 1500xg for 5min The supernatant was then poured into dropper bottles according to the sample and park. These were used to fill two chambers of McMaster slides. The slides were allowed to settle for 5min and then were examined under a light microscope (x 10) for the presence of *Taenia* eggs. Two drops of supernatant were also put on a slide and viewed for the morphological characteristics of eggs as described by Souls by (1987).

### Data analysis

Correlation analysis and the Cochran Q test were used for data analyse. The correlation analysis was used to test the level of association between the prevalence rate of *Taenia* eggs in soil and soil pH while the Cochran Q test was applied to determine if the population proportion of *Taenia* eggs was significantly prevalent than other geohelminth egg types in different soil textures or not and if the population proportion of all helminth egg types are the same for all parks locations. A significance level of 0.05 was adopted for both tests. Statistical package for social sciences (SPSS) version 20 was used for the analysis.

## 4.0 Result and Discussion

### *Taenia* egg count of soil sample of 16 recreational parks

A total of 12,290 eggs per gram of soil samples of 16 recreational parks in Abuja were found in the laboratory. Of this, the Millennium Park had the highest egg count of 3,640 (29.61%) followed by Jabi lake Park with 2,020 (16.44%). Orbit Garden had 1800 (14.65%), followed by Wuse Market Park with 1,220 (9.93%), both Eden and Executive Gardens had 160(1.30%) each. The least egg count was found in Queens field Park and Area 1 Zoological Garden with 140 (1.14%) each. Table:3

### Cochran Q Test on Helminth Egg Types for all the selected Parks

The total sample used for the determining the population proportion of Helminth egg types was 184. The Cochran Q test statistic value of 94.87 of 8 df with a probability value (P-value) of 0.0001 indicates that the prevalence population proportion of helminthes egg types were significantly different for all the parks' locations. Hence the first null hypothesis is rejected. Zero (0) indicates absence of helminth egg types 1 and indicates presence of helminth egg types. The prevalence rate of helminth egg types is presented on Table; 4.1

In this study, it was observed that 99.5% of the soils sampled in the 16 parks in Abuja Central Area were contaminated with eggs of one geohelminth or the other. There was a 72.2% contamination rate for *Taenia* eggs shown by this study, which is considered high. Sample collection was carried out towards the end of the rainy season. Although, according to Smith *et al* (1984), rainfall may wash eggs away in an open park, the poor drainage in most of the parks may have been responsible for the high rate of contamination. Further, the high number of humans that patronize these parks with the possibility of helminthes eggs' picked by soles of shoes as well as access to these parks by animals such as dogs through the broken down fence or unfenced parks, could result in the high level of contamination with eggs. (Paquate-Durand *et al*, 2007; Avoiglo and Balkaja, 2011). There were insufficient sanitary facilities in the parks which poses as a risk factor in the faecal contamination of soils. This is in line with the findings of Schantz *et al*, 1998 who identified low level of sanitary infrastructure e.g. toilets as a risk factor associated with cysticercosis in humans.

In this study, Eden Park had a lower prevalence of parasitic eggs (1.3% egg count). This could be attributed to the lower number of people that visit the park on account of size and preference. Millennium Park had the highest level of contamination although on aggregate terms, the other sites may equally be contaminated. This can be attributed to the fact that Millennium Park is more than the twice the size of each of the other Parks and had the highest patronage. Also, faecal contamination may be a significant factor as the park had only one functional toilet to serve thousands of residents that patronize it. Further, there is a stream that cuts through the length of the park where waste water from other locations within the FCT passes through. This may serve as a good distribution channel for the *Taenia* eggs as demonstrated by the findings of Dagny *et al*. (2010).

Table 1: Park Prevalence Rate of Helminthes Eggs in Recreational Parks

Park	No. of samples per Park	No. Positive	% Positive
Nisa leisure	16	3	8.70
Gilmore	15	3	8.15
Millennium	24	12	13.04
Jabi lake	16	6	8.70
UDBN	12	2	6.52
Berger	16	3	8.70
Orbit garden	16	6	8.70
NUDB	6	1	3.26
Tender vine	6	2	3.26
Eden	16	2	8.70
Cortland garden	5	0	2.72
Queen fields	4	1	2.17
Executive garden	4	1	2.17
Circles	6	2	3.26
Area 1	6	1	3.26
zoological			
Wuse market	16	4	8.70
<b>Total</b>	<b>184</b>	<b>49</b>	<b>100:00</b>

**Table 2: Park Prevalence Rate of *Taenia* Eggs in Recreational Parks**

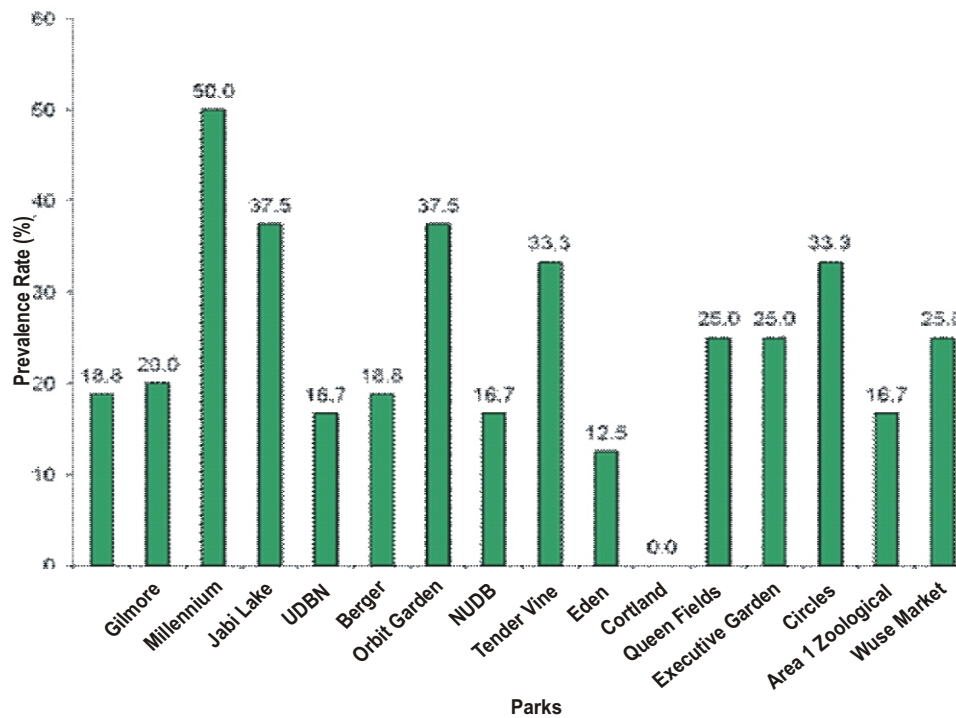
Park	No. of samples per Park	No. Positive	% Positive
Nisa leisure	16	3	6.12
Gilmore	15	3	6.12
Millennium	24	12	24.49
Jabi lake	16	6	12.25
UDBN	12	2	4.08
Berger	16	3	6.12
Orbit garden	16	6	12.25
NUDB	6	1	2.04
Tender vine	6	2	4.08
Eden	16	2	4.08
Cortland garden	5	0	0.00
Queen fields	4	1	2.04
Executive garden	4	1	2.04
Circles	6	2	4.08
Area 1	6	1	2.04
zoological			
Wuse market	16	4	8.16
<b>Total</b>	<b>184</b>	<b>49</b>	<b>100.00</b>

**Table 3: Percentage *Taenia* eggs count per gram in Abuja Recreational Parks**

S/N	Park	No of Samples	Total Egg Count/Park	<i>Taenia</i> Egg Count/Park	% Egg Count/ Park
1	Nisa Leisure	16	3024	860	6.10%
2	Gilmore	15	1934	420	3.42%
3	Millennium	24	10155	3640	29.61%
4	Jabi Lake	16	5260	2020	16.44%
5	UDBN	12	2150	510	4.15%
6	Berger	16	3180	560	4.56%
7	Orbit Garden	16	3700	1800	14.65%
8	NUDB	6	320	100	0.81%
9	Tender vine	6	500	180	1.46%
10	Eden	16	1440	160	1.30%
11	Cortland	5	0	0	0.00%
12	Queensfield	4	300	140	1.14%
13	Executive Garden	4	680	160	1.30%
14	Circles	6	1660	380	3.09%
15	Area 1	6	1540	140	1.14%
16	Zoological				
	Wuse Market	16	2720	1220	9.93%
	<b>Total</b>	<b>184</b>	<b>38563</b>	<b>12290</b>	<b>100.00</b>

**Table 4: Mean *Taenia* egg per Abuja Recreational Park**

S/N	Park	No of Samples	<i>Taenia</i> Egg Count/Park	Total Egg Count/Park	% Egg Count/Park	Mean Egg Count
1	Nisa Leisure	16	860	3024	28.44%	53.75
2	Gilmore	15	420	1934	21.72%	28.00
3	Millennium	24	3640	10155	35.84%	151.67
4	Jabi Lake	16	2020	5260	38.40%	126.25
5	UDBN	12	510	2150	23.72%	42.50
6	Berger	16	560	3180	17.61%	35.00
7	Orbit Garden	16	1800	3700	48.65%	112.50
8	NUDB	6	100	320	31.25%	16.67
9	Tender vine	6	180	500	36.00%	30.00
10	Eden	16	160	1440	11.11%	10.00
11	Cortland	5	0	0	0.00%	0.00
12	Queensfield	4	140	300	46.67%	35.00
13	Executive Garden	4	160	680	23.53%	40.00
14	Circles	6	380	1660	22.89%	63.33
15	Area 1 Zoological	6	140	1540	9.09%	23.33
16	Wuse Market	16	1220	2720	44.85%	76.25
Total		184	12290	38563		<i>P</i> -value = 0.115



**Fig. 1 Park Prevalence rate of *Taenia* eggs in Soils Samples of Abuja Recreational Parks**

#### 4.5 Questionnaire Analysis

A total of 200 questionnaires were distributed and returned. Of the 16 Recreational Parks sampled, Millennium Park was the most patronized than the other parks. (Fig 2)

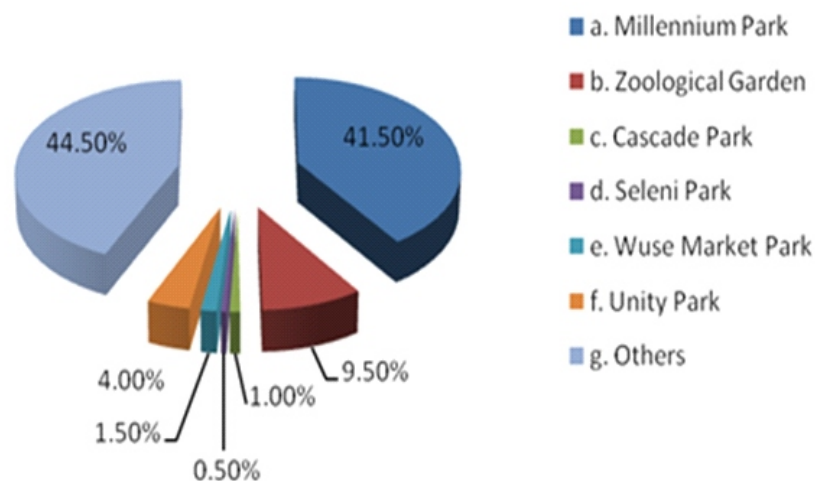
In response to the question on the sufficiency of provision for cleaning up at the parks, 158 (79.0%) opined that parks in Abuja have sufficient provision for cleaning up, while 38 (19.0%) thought the provision was inadequate. Four (2.0%) did not respond.

One hundred and fifty three (76.5%) out of 200 respondents said they eat in the parks, 45 (22.5%) don't eat at parks, 2(1.0%) did not respond. (Fig 3)

Ninety (45.0%) of respondents said they had cause to come in contact with soil at the parks, out of which 69 (34.5%) said they sat on the grasses, 12 (6.0%) said they play in sand with children, 2 (1.0%) said they like playing with sand at the parks, 11 (5.5%) said when they clean or dust children up and 4 (2.0%) said when they help children put on shoes at the end of a visit to the parks. Twelve (6.00%)of the respondents said they have never had cause to come in contact with soil at parks.(Fig 4)

The high percentage of individuals that come in contact with soil one way or the other is an indication of number of people that may be at risk where proper sanitary actions (Such as hand washing) are not taken.

There is a need for more public enlightenment on mode of transmission of helminth infection and the significance of hand washing as a means of protection from contamination.



**Fig 2. Response to frequency of Recreational Park visits**

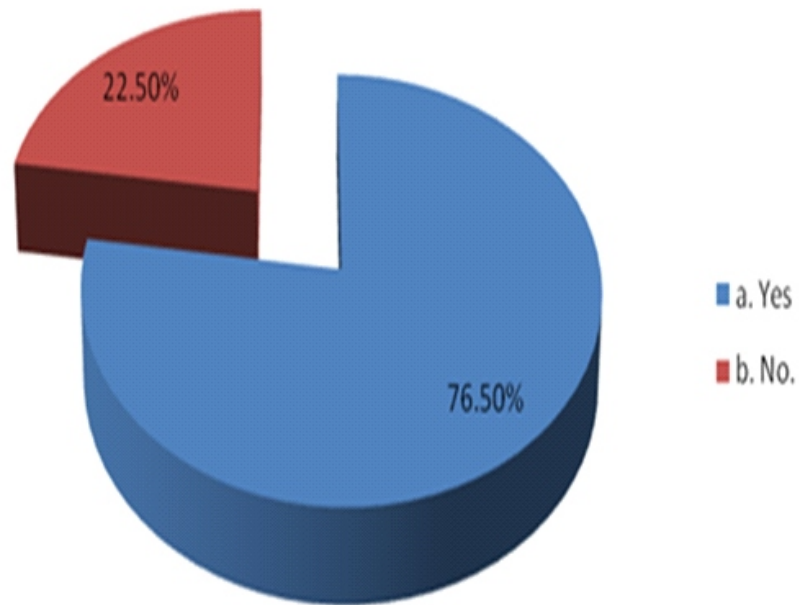


Fig 3. Response to eating at the Park

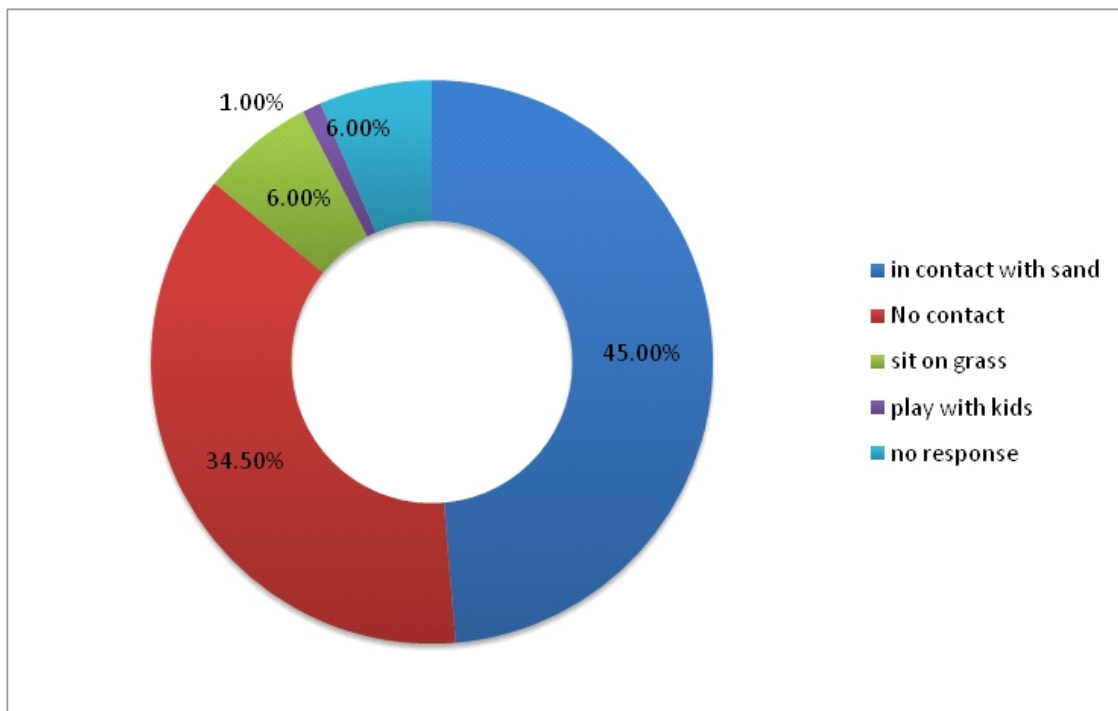


Fig 4. Response to coming in contact with Soil in Recreational Parks



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