High-level parasitic contamination of soil sampled in Ibadan metropolis

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Abstract

Soil transmitted helminthes infections are common chronic human infections worldwide, this has been recognized as an important health problem, particularly in developing countries. The study was conducted within Ibadan metropolis in Oyo State, south western Nigeria between September 2008 and March 2009 to determine the prevalence of intestinal parasite in soil samples within the city. A total of 102 soil samples were collected from different sources from five local government areas ranging from refuse dumps, vegetable farms, school play grounds, abattoir, hospital, vicinity of house, gutter and road side. Two different methods of concentrating ova/cysts of parasites were used to analyze the samples – the zinc sulphate floatation technique and concentrated glucose solution method. Fifty-seven (55.9%) soil samples were positive for one or more parasites. These included; hookworm (37.3%), *Strongyloides stercoralis* (20%), *Entamoeba histolytica* (18.7%), *Ascaris lumbricoides* (17.3%), *Trichuris trichiura* (6.7%) respectively. The total number of parasites recovered was 75 (73.5%) and 74 (98.7) of these were recovered by the zinc sulphate floatation technique while only 44% was recovered by the concentrated normal saline-glucose solution technique. This study thus established the high prevalence rate of intestinal parasites in the soil sampled in Ibadan city and this obviously is one major means by which residents are at risk of parasitic diseases and also one of the means of vegetable contamination.

Key words: *Soil, Intestinal parasites, Contamination, Ibadan*

Résumé

Les infections helminthiques transmises du sol sont communément les infections humaines chroniques infections sur le plan mondial, ceci a été reconnu comme un important problème de santé particulièrement dans les pays sous-développés. L'étude était conduite dans la ville métropolitaine d'Ibadan, Oyo State, Sud ouest du Nigeria entre Septembre 2008 à Mars 2009 pour déterminer le taux des parasites intestinaux dans les échantillons de sol dans la ville. Un total de 102 échantillons de sol était collecté de différentes sources de cinq districts variant des lieux de refuges, champs de légumes, cours de recréations, abattoir, hôpital, maisons environnement, rigoles et bordures des voies. Deux méthodes différentes de concentration des ova/ cystes des parasites étaient utilisées pour analyser les échantillons– the zinc sulfate floatation technique et la méthode de solution concentré de glucose. Cinquante six (55.9%) des échantillons sol examinés révélaient: hookworm (37.3%), *Strongyloides stercoralis* (20%), *Entamoeba histolytique* (18.7%), *Ascaris lumbricoides* (17.3%), *Trichuris trichiura* (6.7%) respectivement. Le nombre total de parasites récoltés était de 75 (73.5%) et 74 (98.7) de ceux ci étaient récoltés par la technique de flottation de sulfate de Zinc. Cependant, seulement 44% était récolté par la technique de solution concentrés d'eau salée et de glucose. Cette étude établit un taux de prévalence des parasites intestinaux dans l'échantillon de sol à Ibadan et surement ceci est un moyen majeur par lequel les résidents sont à grand risqué des maladies parasitaires et aussi un moyen de contamination des légumes.

Introduction

Soil transmitted helminthes infections are common chronic human infections worldwide [1, 2], this has been recognized as an important health problem, particularly in developing countries [3, 4]. The geo-helminthes include *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, *Strongyloides stercoralis*, etc. The major obstacle to the implementation of cost effective control is the lack of accurate description of the geographical distribution of infection. Ch ldren

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in developing countries become the most important vulnerable group to these infections since they usually play within the grounds [5].

Faecal examination is the most simple and reliable method of detecting parasitic infection and that is the reason many epidemiological studies on parasitic infections have been done on faeces [6]. Many morbidity surveys including faecal examination for intestinal parasites have been performed among people who live in rural areas in developing countries revealing high infection rates of human intestinal parasites [7]. However results obtained in this method do not directly indicate the extent to which residents are at risk of parasitic diseases, but simply demonstrate only the point of prevalence. Thus soil contamination seems to be the most direct indicator of risk [4].

When the soil becomes contaminated, the eggs in soil can be transferred onto vegetables, then onto the hands and transferred directly into the mouth [8] or ingested by eating raw vegetables [9]. Intestinal parasites have been found to adhere to vegetables, fruits, fingers, utensils, and money [3]. We previously determined the level of parasitological contamination of vegetables sold in some major open markets in South Western part of Nigeria. The results showed that Eighty-two (68.3%) of the vegetables were positive for intestinal parasites from which water leave (*Talinium triangulare*) and 'soko' (*Celosis*) recorded the highest (100%) parasitic contamination [10]. Parasites detected were *Ascaris lumbricoides*, hookworm, *Taenia* spp, *Strongyloides stercoralis* and *Balantidium coli* [10]. This study therefore examined soil samples at different locations in Ibadan city for the presence of intestinal parasites as a reservoir for parasitic infection.

Material and methods

Sample collection

The study was conducted in Ibadan the capital city of Oyo State, situated at Oyo south senatorial district, South western Nigeria. The city is the second largest city in Africa and falls within the rain forest belt. It is densely populated with various categories of people, some of which are peasant farmers, traders and artisans. Some also engage in private businesses and civil service work. The dominant ethnic group is Yoruba. The interior part of the city is more densely populated with houses without efficient toilet facilities, forcing the occupants to visit bushes, refuse dump and open gutters for defaecation. Few houses in the area are served by pit latrines. The central parts are occupied mostly by the middle class whose houses have water closets with soak away pits. The drainage system consists of open gutters, often littered with refuse and eroded soil.

Five local government areas within the city were chosen for the study. These included the South East, South West, Akinyele, North West, and Ibadan North local government areas. The following number of samples; 22, 18, 20, 18, and 24 were collected respectively. Sampled areas included market squares, refuse dumps, mechanic workshops, residential houses, vegetable farms, gutters, abattoirs, around the town football play grounds, schools and motor parks.

About 200 g of soil was scrapped from soil surface with a hand shovel and stored in a sealed and labelled plastic containers. Samples were kept in the laboratory at room temperature until they are ready for processing.

Zinc sulphate floatation technique

About 5 grams of the soil sample was mixed thoroughly with distilled water. The suspension was strained through a net mesh to remove coarse particles. The filtrate was centrifuged at 1000 rpm for 3 minutes and supernatant decanted. The resultant sediment was further broken up by shaking and tapping the tube. The sediment was mixed with Zinc sulphate solution (specific gravity 1.2). This was added to the brim of the test tube and allowed to stand for a few minutes with a cover slip on the tube to collect any floating egg. The cover slip was then removed and examined under the microscope at X10 and X40 objectives [11].

Standard (Waenlor and Wiwanitkit) method

Samples were taken to the laboratory, dried overnight at room temperature, and sifted through sieves of 150 μm meshes. About 2 g of the powdery sand was suspended in about 8 ml of normal saline-glucose solution for 30 minutes. The suspension was centrifuged at about 1000 revolutions for 1-2 minutes. The floated eggs were removed with the aid of a squarely cut glass rod and transferred to a slide for examination under X10 and X40 objective of the microscope [2].

Results

Of the 102 soil samples collected from various locations within the five local government areas in the city, 57 (55.9%) were positive for ova, cysts or larvae of one or more parasites. Hookworm was the most frequently encountered with a prevalence of 28 (27.5%), *Strongyloides stercoralis* 15 (14.7%), *Entamoeba histolytica* 14 (18.7%), *Ascaris lumbricoides* 13 (12.7%) and *Trichuris trichiura* 5

(4.9%). The South East local government recorded the highest level of parasitic contamination with 18 (81.8%) positive samples while Ibadan south West recorded the least parasitic contamination of 6 (33.3%) (Table 1).

parasites recovered was 18, as some soil samples recorded more than one parasite. The least contaminated soil sample was school play grounds (20%). Vegetable farms had 50% incidence of parasitic contamination. Others included; markets 8/

Table 1: Prevalence of intestinal parasites in soil samples at various local governments

Local Government Areas	No of Samples	*E. histolytica*	*A. lumbricoides*	*T. trichiura*	Hookworm	*S. stercoralis*	Sample with Parasites
Ibadan North	24	0 (0)	0 (0)	2 (8.3)	6 (25)	7 (29.2)	15 (62.5)
Ibadan South East	22	6 (27.3)	6 (27.3)	3 (13.6)	13 (59.1)	1 (4.5)	18 (81.8)
Akinyele	20	4 (20)	0 (0)	0 (0)	7 (35)	1 (5)	9 (45.0)
Ibadan South West	18	2 (11.1)	4 (22.2)	0 (0)	0 (0)	2 (11.1)	6 (33.3)
Ibadan North West	18	2 (11.1)	3 (16.7)	0(0)	2 (11.1)	4 (22.2)	9 (50.0)
Total	102	14 (13.7)	13 (12.7)	5 (4.9)	28 (27.5)	15 (14.7)	57 (55.9)

Table 2: Prevalence of parasites from source of soil sample

Source	No of Samples	Sample with Parasite	*E. histolytica*	*A. lumbricoides*	*T. trichiura*	Hookworm	*S. stercoralis*	Total Parasite
Refuse Dump	18	14 (77.8)	2 (11.1)	2 (11.1)	2 (11.1)	8 (44.4)	4 (22.2)	18 (100)
Vegetable farm	4	2 (50)	2 (50)	1 (25)	0 (0)	0 (0)	1 (25)	4 (100)
Market	14	8 (57.1)	1 (7.1)	2 (14.3)	0 (0)	2 (14.3)	3 (21.4)	8 (57.1)
Gutter	10	8 (80)	3 (30)	1 (10)	1 (10)	5 (50)	3 (30)	13 (130)
Vicinity of House	18	9 (50)	2 (11.1)	2 (11.1)	1 (5.6)	6 (33.3)	0 (0)	11 (61.1)
Abattoir	3	2 (66.7)	1 (33.3)	0 (0)	0 (0)	2 (66.7)	0 (0)	3 (100)
School Play Ground	10	2 (20)	0 (0)	2 (20)	0 (0)	0 (0)	0 (0)	2 (20)
Road side	20	10 (50)	2 (10)	2 (10)	1 (5)	3 (15)	3 (15)	11 (55)
Hospital	5	3 (60)	1 (20)	1 (20)	0 (0)	2 (40)	1 (20)	5 (100)
Total	102	58 (56.9)	14 (13.7)	13 (12.7)	5 (4.9)	28 (27.5)	15 (14.7)	75 (73.5)

Table 3: Recovery rate of 75 intestinal parasites with the techniques

Parasites	Zinc sulphate floatation	Concentrated normal saline-glucose
E. histolytica	14 (18.7)	0 (0)
A. lumbricoides	13 (17.3)	13 (17.3)
T. trichiura	5 (6.7)	5 (6.7)
Hookworm	27 (36)	13 (17.3)
S. stercoralis	15 (20)	2 (2.7)
Total	74 (98.7)	33 (44)

ZSF- Zinc Sulphate Floatation Method
CNG- Concentrated Normal saline-Glucose Method
( ): Number in parenthesis is percentage

Soils sampled from refuse dumps were the most contaminated with 14/18 (77.8%) soil samples contaminated with parasites. The total number of

14 (57.1%), Gutters 8/10 (80%), vicinity of houses 9/18 (50%), and hospitals 3/5 (60%) (Table 2).

Zinc sulphate floatation method, yielded more parasites 74/75 (98.7%) than concentrated glucose solution method 33/75 (44%) (Table 3).

Discussion

Soil samples collected from various local government areas revealed high level of parasitic contamination. This wide spread contamination of soil samples with cysts, eggs and larvae of intestinal parasites is epidemiologically significant. This finding is similar to other studies reported in Nigeria [12, 13] and other countries of the world [14]. For example, the study of Van Niekerk *et al.* [15] found that the high prevalence of intestinal parasitic infestation in urban children, Cape Town, suggested extensive contamination of soil in the area by parasitic ova.

The presence of potentially pathogenic helminth parasites in the environment highlights risk of human infection. The finding of Alonso *et al.* [16] also suggested that in Resistencia, subtropical city in Argentina, human infection with *Toxocara* are likely to occur within the limits of housing estates, which has the higher contamination in soil samples recovered, rather than in public park or open spaces. The viability of these parasite eggs and larvae under different environmental conditions is focal in transmission of parasitic diseases. Apart from risk resulting from accidental ingestion of contaminated soil, just walking around these environment unprotected predisposes humans to infections. The survey carried out in the University College Hospital Ibadan in 2005 revealed that 5.3% of all the children (0-5 years) with diarrhoea were found to have *Strongyloides stercoralis* [17], and according to their report the infection can be traced to soil contamination with the parasite infective larvae, as children within this age range play on the ground and even eat the sand (geophagia). In rural Guinea, Africa a high prevalence of geophagia among children partially explained a high rate of intestinal parasitism [18]. This may also be the case here in Ibadan city.

Attempts to isolate the parasite eggs from the soil have been made in many countries of the world. The soil sample collected from parks, playgrounds or sand pits in many countries such as Argentina, Zimbabwe, Japan revealed presence of *Toxocara* eggs [16, 19, 20]; showing that the soils in these countries are contaminated with pet faeces. On the other hand, in many countries in the tropical areas, little attempts have been made to detect the parasite eggs from the soil. However, in a similar study reported in Makurdi, Benue state in Nigeria, where prevalence of zoonotic diseases has been a major problem, the soil samples were taken from areas where livestock farming is practiced. The study revealed the presence of *Toxocara canis, Ascaris sunm, Ascaris bovis, Ancylostoma caninum, Trichuris vulpis, and Strongyloides* species [11]. These are animal intestinal parasites, a clear indication of soil contamination with animal faeces. There have been few other similar studies reported in other tropical countries especially in the Southeast Asian region, especially Thailand [4]. That study focuses in a slum community in the Southern region of Thailand, where the geohelminthic infection is prevalent [4, 21]. Here in Ibadan city, the parasites recovered were essentially of human origin; *Entamoeba histolytica, Ascaris lumbricoides,* hookworm, *Strongyloides stercoralis and Trichuris trichiura.* This is an indication of soil contamination with human faeces, revealing a substandard sanitation, poor personal hygiene, overcrowding and poverty.

The study was carried out during the dry season (September and March), samples collected one or two days after rain yielded more parasites. Despite the dry weather, the soil samples still yielded this high level of contamination when you have high rates of desiccation because of high temperature when parasite eggs and larvae do not survive. This is similar to the study carried out by Nurdian [22]; in the rainy season, 65% of soil samples were contaminated with all four species of intestinal parasite eggs but in the dry season, only two species were detected. With year-round variation in temperature and degree of aridity considered, the decreased prevalence and parasite detection was concluded owing to dryness of the soil. It is our opinion that the level of parasitic contamination during the rainy reason may be very alarming.

The prevalence of parasites from the sources ranged between 20 to 130%.; gutter having 130% due to multiple parasites per sample, refuse dump, vegetable farm, abattoir and hospital having 100%. When the soil becomes contaminated, the eggs in soil can be transferred onto vegetables then onto the hands and transferred directly into the mouth [8] or ingested by eating raw vegetables [9]. Intestinal parasites have been found to adhere to vegetables [3, 10] fruits, fingers, utensils, and money [3]. Human habitation and soil contamination by many other animals near residences are considered reasons for these conditions. Near residential areas is kept constantly moist by roofs and water used in daily life, thus facilitating egg survival. Soil contamination with parasite eggs in the house vicinity of the study sample was an important problem in the study area. This suggests that in one direction, an infected resident may pass the intestinal parasite eggs and contaminate the soil. In the opposite direction, contamination of intestinal parasite eggs in the soil may increase the risk of infection among the residents [22].

The zinc sulphate floatation method in which the samples were analyzed immediately after collection (still in their wet state) recovered more parasite larvae and eggs than the concentrated normal saline-glucose solution recommended by Waenlor and Wiwanitkit [2], which required an overnight drying of the soil samples before analyzing. Mostly, eggs were recovered with this method and a few larvae recovered were dead and distorted.

This study thus established high prevalence rate of intestinal parasites in the soil in Ibadan city and this obviously is one major means by which residents are at risk of parasitic diseases and also one of the possible means of vegetable contamination.

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