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The prevalence, pathogenesis and control of canine and human toxocariosis in Ibadan, Nigeria

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Abstract

Five hundred and sixty four dogs of under 3 years of age from a total of 1,620 that were presented at the Veterinary Teaching Hospital Clinic at the University of Ibadan, Ibadan between April and August 2003 were screened for *Toxocara canis*. Also a total of 128 children of below 11 years of age from some schools at the immediate vicinities of 5 playgrounds in Ibadan, from a total of 1,012 volunteers were clinically examined and scored on given guidelines for the diagnosis of Viscera Larva Migrans (VLM). They were again screened by the *Toxocara-Elisa* assay for VLM, while their area playgrounds were evaluated for *T. canis* eggs. Group prevalence for canine *Toxocariosis* was 64.9% by the flotation method, while VLM was 87.5% by the ELISA. Mean *T. canis* egg counts were significantly higher($p<0.05$) than the 2.1 eggs/5.0 grams of soil recommended for human safety from ascariosis in the two unfenced playgrounds at Bodija and Ijokodo areas than in the other three that are fenced. The most susceptible group (2 – 5 yrs) had the highest titre for *T. canis*($1.62 – 3.10_E$) and also came from these high "risk" playgrounds at Bodija and Ijokodo. Dog faecal contamination of soils was observed to be higher in the same unfenced playgrounds than in the fenced. While all playgrounds are recommended for fencing, veterinarians are also challenged to intensify control efforts on dogs by using larvicidal anthelminthics to reduce environmental contamination. Children should be treated periodically,and also educated formally on the need to develop a good personal hygiene habits in order to avoid the dangers of both the VLM and the more serious OLM.

Keywords: Faeces, Ibadan, Nigeria, Prevalence, Ibadan, Soil, Toxocariosis
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Introduction

Toxocara canis and *T. cati*, the common roundworms of the dog and cat respectively, are cosmopolitan species and are known to infect man as well, resulting in a condition known as visceral or ocular larval migrans (VLM/OLM) (Woodruff 1976; Woodruff 1984). Adult worms live in the small intestine and shed eggs into the environment via faeces of the host to contaminate and infect man. The eggs, when first shed, are **not** capable of infecting another host. Under optimal environmental conditions, the eggs take 2 to 7 weeks to mature to infective embryonated 2nd stage larva (L_2), (Lloyd, 1998). Dogs can be infected in 4 ways, each of which has its distinct characteristic viz. (a) ingestion of infective embryonated (L_2) eggs (b) ingestion of infective larval with paratenic hosts e.g. rat/mice (c) ingestion of infective larvae with mother's milk (perinatal/neonatal) and (d) acquisition of larvae *in uterus* (prenatal). Its prevalence in dogs depends on many factors such as age, sex, geographical area, diagnostic methods and worming history (Barriga, 1988; Lloyd, 1998). Canine toxocariosis could be mild or moderate manifesting principally as pot-belly, dry starring hair coat, occasional diarrhoea, leucocytosis, eosinophilia and general unthriftiness, but fatalities have resulted from massive pulmonary invasion in prenatally infected puppies (Urquhart *et al*., 1996). In general canine toxocariosis is a disease of high prevalence in the tropical and other environments (Wiseman & Woodruff, 1971) and the high prevalence had been sustained by some epidemiological factors which include (i) high fecundity of female *T. canis* to lay well over 700 eggs/gm/day, which make possible a count of 1500 e.p.g per pup (ii) high resistance of *T. canis* eggs to climatic extremes-making survival on ground to last many years and (iii) constant reservoir of infection (hypobiotic larvae) in tissues of bitches that are insusceptible

to most common anthelmintics (Urquhart *et al.,* 1996). VLM or OLM, on the other hand, is due to the massive invasion of viscera organs by the developing larvae, which manifest as fever, leucocytosis, persistent eosinophilia, hypergammaglobulinemia, elevated anti-A or anti-B isohaemagglutinins and hepatomegaly (Glickman *et al.,* 1979).

The disease is usually self-limiting, if the patient is removed from the source of infection, but fatalities have resulted from extensive larval invasion of the brains (Moore*,* 1962*)* or myocardium (Becroft*,* 1964*)*. Human infection has been proved to be principally through the ingestion of food contaminated with the faeces of infected dogs *(*Barriga 1991), pica habits especially of children (Shrand*,* 1964*)* and contact with dogs at home or clinics *(*Wolfe & Wright*,* 2003). Children are considered to be particularly at risk from infection because of their childhood geophagia habits, close association with pets and playgrounds (Snow *et al* 1987*).*

VLM, though a benign and self-limiting zoonosis, has been of global concern in the paediatric population, first because of its greater severity in children with systemic involvements and secondly because of ocular involvement (OLM) which could lead to visual impairment (Duguid, 1961*)*. Efforts are being intensified globally on the diagnosis and control of dog and cat-borne zoonoses (WHO 1978; WHO 2002*)* and veterinarians and the veterinary profession are specially challenged in this renewed global efforts. The Nigerian Veterinarians, especially the practicing private ones cannot ignore this clarion call.

The purpose of this present study was to evaluate the prevalence, pathogenesis and control methods for both canine and human toxocariosis in Ibadan Nigeria, given our low level of environmental hygiene, large number of stray/ownerless dogs and the indiscriminate defecating habits of dog and man.

Materials and Methods

In animal patients: dogs

Five hundred and sixty four (564) dogs from a total of 1,620 dogs presented at the Small Animal Clinic of the University of Ibadan, Ibadan from April to August 2003 were sampled. Selection criterion was a history of no treatment against worms in the preceding 2 months.

Faecal sampling: All dogs were clinically examined on presentation. Signalmen as well as findings were recorded. Fecal samples were collected into sterile bottles directly from the rectum of each dog for coprology. These were later processed by the method of flotation in saturated common salt solution and egg identification and counting by the modified Mc Masters technique as described in the manual of veterinary parasitological Laboratory techniques (MAFF*,* 1986*)*. A cut-off value of 50 eggs per gram (e.p.g) of faeces was used to identify positive cases (MAFF*,* 1986).

Blood Sampling: Five millilitres of blood was collected into sterile bottles with EDTA as anticoagulant for haematology.

Haematology: This was done on a coulter counter S-Plus® (Coulter Electronics, Hialeah, Fla.). Heamoglobin concentration, haematocrit and total red cell counts were assessed directly while the white blood cell counts were done after the lysis of the red cells with 1.0% formalized saponin solution *(*Schalm *et al.,* 1975).

In human patients: school-age children volunteers

A sample of 128 pupils selected from a total of 1,012 from 7 Nursery and Primary schools located within the vicinities of five popular public playgrounds at Bodija, Agodi, Eleyele, Sabo and Ijokodo areas of Ibadan were assayed for possible viscera larvae migrans (VLM) on defined clinical criteria (*Glickman et al., 1978)* by a qualified medical doctor. Consents were gained through persuasive counseling on the purpose of the exercise and some material gifts. They were all between 2 to 11 years of age (including some pre-nursery children that were staying with their mothers that sell food and drinks around the study area).

Clinical examination was done on the 1,012 volunteers with a focus on the six cardinal clinical signs of VLM viz pronounced leucocytosis (>10,000 mm^3), eosinophilia (>10%), elevated anti-A isoheamagglutinintitre>1:400 or anti-B isohaemgglutinintitre>1:200, an IgG and IgM levels of > 280 above the age and sex specific normal values and hepatomegaly (Glickman *et al.,* 1978).

Blood samples were collected from the volunteers: 4.0 mls into sterile *EDTA* bottles for haematology and another 3.0 mls into sterile tubes for immunoassay. Haematology was done on the same coulter counter S-plus®, while the leucocytes counts were done by haemocytometery, after lysing the red cells with formalized saponin solution.

The isohaemagglutinin and immunoglobulin assessments were done according to Huntley *et al.* (1965) protocols: One hundred and twenty eight (128) of the 1,012 volunteers were clinically positive, based on their clinical scores at the preliminary screening viz.

0 – 2 scores – doubtful [VLM-] patients

3 – 4 scores – possible [VLM?] patients, and

5 – 6 scores – probable [VLM+] patients.

Blood samples for immunoassay were put in plasma aliquot and stored at -20^{0}C until needed.

The indirect microplate enzyme-linked immunosorbent (ELISA) technique (Lofarma lab., Milan, Italy) for the detection of IgG-specific antibodies to *Toxocara canis* excretory- secretory antigens as earlier described by Voller*et al (*1976b) was adopted. This assay was adapted for Toxocariosis by using *T. canis* (L_2) larval secretory antigen (de Savigny*,* 1975*)* obtain from the *in-vitro* culture in chemically defined low molecular weight medium, as detailed in the Lofarma Labpratiry manual.

Toxocara-ELISA was evaluated by testing sera from the three clinically designated groups of volunteers viz VLM-, VLM? and VLM+ that had been examined and scored, with their record of signalments. Negative and positive controls were the 17 and 10 respective imported commercial human sera samples (*Bristol-Mayer Squibb, Bristol, England,www.bms.com)*, provided by the Unit of Peadiatrics, Rural Community Clinic, Ibarapa, in Oyo State. Sensitivity and specificity were estimated to be 78.0% and 92.0% respectively. Results of the Toxocara-ELISA were determined photo-metrically at 405nM and expressed in extinction units E_{405}.Because of the high specificity and quantitative nature of the assay, Woodruff *et al.* (1966) and de Savigny *et al.* (1979) proposed the following interpretative guidelines for its results: values of between 0.50 and 1.50 reflected a relatively low level of circulatory antibody as seen in light-current clinical toxocariosis and values greater than 1.50 suggests a significant level of specific antibody as seen in recent clinical toxocariosis.

In soil

Soil sampling: Samples of topsoils were collected from 5 designated playgrounds that are known to be usually frequented by dogs and humans and also that are near volunteers' schools at Bodija, Agodi, Eleyele, Sabo and Ijokodo areas of Ibadan. The five playgrounds also serve as the collection centres for the bones of slaughter cattles at the adjoining slaughter slabs. Collection was done monthly from April to August 2003 for analysis for worm eggs. Samples were collected 1 to 3 meters apart in a systematic way in lines within the play areas. Soil was taken with a plastic pipe of length 10 cm, with a serrated edge to aid cutting into soil to a depth of about 3cm, providing about 200 gms of soil (Quinn *et al* 1980). After removal of stones and grass, soil samples were stored in sealed polythene bags until processing.

Soil analysis: Soil was analyzed by the method of Quinn *et al* (1980) with one flotation per 25 gm of sample and using saturated Zinc sulphate (specific gravity of 1.32 at 23^{0}C) as the flotation medium. The total number of eggs recovered from each 25-gm sample was counted and differentiated into the following three categories viz. those with larvae, those showing signs of development and those with undivided contents. Dark brown-black, opaque eggs were presumed to be non-viable older eggs (Snow *et al.,* 1987*)*. The first 3 groups were presumed to be potentially viable in this survey as recommended (Quinn *et al.,* 1980*)*.

Statistical analysis

Clinical observations for the age groups were descriptively compared. Worm prevalence, clinical scores, number of worms, ELISA scores of volunteers, as well as the number of eggs per 25 gms of soil from both fenced and unfenced playgrounds were compared by the Chi-squared distribution test, on appropriate contingency tables, using the statistical package for the social sciences, (SPSS0 16.0) (SPSS inc. Chicago, USA). Haemograms of age groups, and the number of eggs per 5 gms of soil from both fenced and unfenced playgrounds were compared with reference values, using the t-distribution test. In all analysis, the crosstab command was used to obtain both the statistics and the associated p-values; which were defined as significant at a level of $p < 0.05$.

Results

Clinical observations on dogs

Clinical signs were unspecific and were generally more severe in puppies under 6 months of age. They consisted of dry skin, pot-belly, starring hair coat, emaciation, anorexia, lethargy and general unthriftiness. Some with diarrhoea and anaemia were seen. These are summarized in age-matched groups in Table 1.

Coprology

Three types of helminths eggs were identified through faecal screening viz *Toxocara canis, Ancylostoma caninum* and some ripe segments of *Dipylidium caninum* in faecal smears, with the highest prevalence in puppies under 12 weeks of age. These are summarized in Table 2. Only counts over 50 e.p.g were considered as positive (MAFF, 1986). Prevalence rates were 64.9%, 54.8% and 16.7% for *T. canis, A. caninum* and *D. caninum* respectively.

Table 1: Major clinical observations on 564 dogs diagnosed of toxocariosis in Ibadan

Age-range groups	№ & % in groups	Some clinical observations
Gp AA (6 wks to 12 weeks) lethargy and failure-to-grow.	386 (68.4%)	Dry skin, pot-belly, starring hair coat, emaciation, serous ocular discharges, occasional diarrhea, anaemia, rectal temperature ranged from 37.7 to 38.4^{0}C
G.p. BB (13 weeks to 6 months) anorexia, lethargy and general unthriftiness.	105 (18.6%)	Pot-belly, dry starring hair coat, rectal temperature ranged from 37.9 to 38.8^{0}C
Gp. CC (7 months to 2 years plus) and occasional diarrhoea and anaemia	73(12.9%)	Dry skin, starring hair coat, lethargy, rectal temperature ranged from 38.2 to 39.4^{0}C

Table 2: Prevalence rates of helminths identified in the faecal samples from dogs presented for treatment in Ibadan

Helminth type	Total Screened	Total positive	Total negative	6 – 12 wks		3 - 6 m		7 m – 1 yr		Over 1 yr		Prevalence
				-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve	
Toxocara canis	564	366^{f}	12^{h}	12^{g}	252^{a}	23^{b}	86^{c}	57^{d}	28^{b}	106^{e}	-	64.9%^{d}
Ancylostoma caninum	564	309^{i}	255^{q}	28^{b}	231^{a}	33^{b}	57^{d}	82^{c}	21^{b}	112^{j}	-	54.8%^{d}
Dipylidium caninum	564	94^{c}	470^{k}	7^{h}	17^{b}	304^{j}	36^{b}	97^{c}	41^{d}	62^{d}	-	16.7%^{b}

Figures with the same letters are NOT significantly different, while those with different letters are significantly difference at 5% level of significance on both horizontal and vertical columns

Table 3: Haemogram of the 564 dogs diagnosed of toxocariosis in Ibadan.

Age group	Hg.(gm/%)	PCV %	RBC count X10^6 mm^3	WBC count /mm^3	Neutrophilis		Lymph	Mono.	Eosino.
					Band	Segmented			
Gp. AA (6-12 wks) (17.6%)	7.4^{c} ±2.2	22.3^{e} ± 3.4	5.87^{f} ± 0.62	15,425^{h}	65^{k} (0.4%)	8,602^{m} (55.8%)	3402^{p} (22.0%)	642^{v} (4.2%)	2714^{w}
Gp. BB 2952^{w} (13 wks-6 m) (17.0%)	8.8^{b} ±3.2	25.4^{e} ± 4.2	5.42^{f} ± 1.62	17,353^{i}	82^{i} (0.5%)	9903^{n} 57.1%)	3702^{o} (21.3%)	714^{q} (4.1%)	
Gp. CC (>7m) (15.4 %)	8.3^{c} ±2.2	25.1^{e} ± 2.8	5.62^{f} ± 2.12	15,632^{h}	64^{k} (0.4%)	8,808^{m} (56.3%)	3,684^{p} (23.6%)	672^{v} (4.3%)	2404^{t}
Local Normal 750^{s} Values: 400 (Oduye, 1978) (5.3%)	12.2^{a} ±3.4	35.2^{e} ± 4.4	5.8^{f} ± 1.81	14,000^{g}	70.0^{j} (0.5%)	8,700^{m} ± 2,250 (62.1%)	3,700^{o} ± 1,200 (26.4%)	722^{q} ±300 (5.2%)	±

Values are expressed as means ± standard deviations

Figures with the same letters are NOT significantly different, while those with different letters are significantly different at 5% level of significance, when compared with the normal values

Haematology

When compared with the local normal range of values (Oduye*,* 1978) both the haemoglobinconcentration and haematocrit values were significantly lower in the 3 age groups. There were pronounced leukocytosis due mainly to eosinophilia in the 3 groups. These are summarized in Table 3.

Toxocara-ELISA results

Three groups were identified based on the preliminary clinical scores viz. scores 0-2, had 16 patients of 8 and above years, 11 males and 5 females, scores 3 – 4 had 38 patients, 27 males and 11 females of 6 to 7 years of age and scores 5 – 6 had 74 patients, 52 males and 22 females of 2 to 5 years of age. Age and sex of volunteers did not influence their clinical scores, but location did, with preponderance for the two unfenced playgrounds at Bodija and Ijokodo (Table 4). However, the volunteers' seroprevalence was negatively correlated with the level of care and maintenance of their playgrounds. The Elisa value range of 1.62 to 3.1E_{405} for younger patients near Bodija and Ijokodo unfenced playgrounds were significantly higher than the values of 0.30 to 0.47 E_{405} for older volunteers at Agodi and Eleyele fenced playgrounds. Group prevalence of VLM among volunteers was 87.5% (male 87.8%., female 86.8%. Thus, the group value was significantly higher ($P<0.05$) than the prevalence of *Toxocara canis* in pet dogs in the same area (Tables 2 & 4).

Soil sampling

Toxocara canis egg counts were significantly higher ($p<0.05$) in the topsoils of the unfenced playgrounds at Bodija and Ijokodo than in the other 3 fenced ones (Table 5). Similarly, mean egg counts per 5.0 gms of soil were significantly higher ($p<0.05$) for the unfenced playgrounds at Bodija and Ijokodo and also significantly higher ($P<0.05$) than the critical values of 2.1 eggs per 5.0 gms of soil needed for human toxocaral infection (Woodruff *et al.,* 1981*)*. Numbers of viable and developing eggs were also significantly higher for the unfenced Bodija and Ijokodo playgrounds than for the others (Tables 5 & 6).

Table 4: Toxocara-ELISA results of 128 volunteers for the Viscera Larva Migrans diagnosis in Ibadan

Volunteers Group	ELISA values related to signalment of volunteers					
Preliminary Clinical Score	VLM Status	№. & Sex Of Patients	% of Patients	ELISA values In E_{405}	Age Range In Yrs	Host Playgrounds
0 – 2	VLM –ve	16[a] 11M 5 F	12.50	0.3 – 0.47	8 and above	Agodi & Eleyele
3 – 4	VLM ?	38[b] 27 M 11 F	29.7	0.70[e] – 1.42		Sabo & Eleyele
5 – 6	VLM +	74[c] 52M 22 F	57.8	1.62[f] – 3.10		Bodija & Ijokodo

Values with different superscripts are significantly different at 5.0% level of significance ($P<0.05$). Group prevalence = 87.5%, while Male prevalence = 87.8% and Female prevalence = 86.8%

Table 5: Number and Development Stages of Toxocara eggs in soil samples from both fenced and unfenced playgrounds in Ibadan

Number of eggs recovered per 25gms soil samples									Total		Mean % +ve in	
									Screened	Positive	UF	F
Playground	0	1 – 5	6 – 10	11-20	21-30	31-40	41-80	80+				
Bodija (UF)	0 (0)	1 (1.9)	6 (11.1)	4 (7.4)	16 (29.6)	15 (27.8)	12 (22.2)	0 (0)	55	54	98.9[a]	
Ijokodo (UF)	2 (4.5)	4 (9.0)	1 (2.2)	13 (29.5)	4 (9.0)	6 (13.6)	11 (25.0)	3(6.8)	44	44		
Agodi (F)	13 (23.6)	5 (9.0)	12 (21.8)	5 (9.0)	10 (18.2)	8 (14.5)	13 (23.6)	2(3.6)	55	55	77.4[b]	
Eleyele (F)	10 (22.7)	3 (6.8)	0 (0.0)	2 (4.5)	4 (9.0)	14(31.8)	8 (18.1)	3 (6.8)	64	44		
Sabo (F)	8 (21.0)	7 (18.4)	2(5.3)	2 (5.3)	6 (15.8)	3 (7.9)	2 (5.3)	0 (0.0)	58	38		

F = fenced, UF = unfenced

Figures with the same letter are NOT significantly different, those with different letters are significantly different at 5% level of significance

Table 6: Number and Development stages of *Toxocara* eggs in soil samples from both fenced and unfenced playgrounds in Ibadan

Bodija (UF) (UF)		Ijokodo	Agodi (F)	Eleyele (F)	Sabo (F)
№ of soil samples (25 gms)	54	44	55	44	38
Eggs: Total number	810	804	415	322	304
Mean № per sample (25 gms)	15.0	18.3	7.5	7.3	8.0
* Mean № per 5.0 gms	3.0	3.7	1.5^{b}	1.5^{b}	1.6^{b}
Viable eggs: Total number	215	248	186	146	138
% of total	29.9	30.8	44.8	45.3	45.4
Developing eggs: № (with larvae)	324	342	122	108	113
% of total	45.0	42.5	29.4	33.5	37.2
	UF			**F**	
% of viable eggs/5gm in unfenced ground		3.35^{a}			
% of viable eggs/5gm in fenced grounds				1.53^{b}	

* Reference value sufficient for human infection of *Toxocara* species egg is 2.1^{b} eggs per 5.0gm. of soil (Woodruff *et al.,* 1981)

Figures with different superscripts are significantly different at 5% level of significance, when compared with the normal reference value

F = fenced, UF = unfenced

Discussion

The prevalence rate of 64.9% for canine toxocariosis in this survey suggests a high probability of prenatal infection in the very young puppies of less than one year of age. Also, most of the faecal samples that were negative for *T. canis* or those with less than 50 e.p.g were from older dogs with some sizable level of the acquired resistance to infection (Table 2). The value of 64.9% in this study is higher than the 36.5% reported for dogs in Ibadan by Wiseman & Woodruff (1971) thirty-seven years ago and also higher than what Ajayi & Duhlinska (1998) and Ajayi *et al* (2000) recently reported from Jos, Nigeria. However, the significantly lower values in the two earlier reports might not be unconnected with different sampling techniques in these earlier studies, theirs being more randomized and city-wide than our institutional- based survey. Given that prevalence rate of an helminth disease or infection is affected by several factors, including the worming efficacy of the breeding bitches and their litters (Burke & Roberson, 1983), the current higher prevalence is suggestive of negligence and /or irresponsible pet ownership and indicts both the pet owners and their veterinarians, on one hand and the public health workers that are charged with the responsibility of public sanitation, on the other. The same prevalence of *T. canis* in dog is also suggestive of higher rate of environmental contamination by faecal droppings and a higher risk of contacting the VLM or the more severe OLM, especially by children. A situation which had earlier been reported by Ajayi *et al.* (2000). Some of these children are immunologically incompetent but yet, more associated with the environment and at a greater risk of developing the unhygienic habits of nail biting, thumb sucking and other geophagia. Ordinarily, canine *toxocariosis* is a mild and insidious infection of puppies that goes with life-threatening anaemia only when complicated by the blood-sucking *Ancylostoma caninum* as seen in this study, but the risk of environmental contamination that goes with the uncomplicated cases constitutes even a bigger epidemiological problem. A workable and practical advice that could stem the tide, is the use of larvicidal anthelmintics on the bitch before mating and again on her litter shortly after whelping. Burke & Roberson, (1983) reported one of such successful treatment regimen with febendazole from day 42 of pregnancy to 2 weeks after whelping.

Perhaps, the more worrisome aspect of *Toxocara canis* pathogenicity is its ability to cause VLM or OLM in humans, and even the in apparent infection in children (Bass *et al.,* 1983), through the invasion of viscera by the infective larvae (L_2). A group prevalence of 87.5% obtained for VLM amongst the volunteers in this study was alarmingly high, given the global tide on this zoonosis. This figure however compares favourably well with a figure of 86.0% obtained by a similar ELISA method for some rural children in Anse-la-Raye in St. Lucia, (Caribbean community) by Thompson *et al.* (1986) in 1986 and which was described as the highest for any community then. In similar vein, a figure of 87.5% in 2003 definitely would be more than worrisome for both the medical and veterinary professions that have been charged for the control of this benign zoonosis.

Incidentally, clinical scores for both VLM and OLM did not correlate with both the age and sex of volunteers as earlier reported by Holland *et al.* (1998), but the antibody level did, with a negative correlation with age. According to Glickman & Schantz, (1981), antibodies to Toxocara larvae can persist for many years, following initial infection. On this note, it could be assumed that the older volunteers were actually infected when they were younger and that the antibodies were boostered by further exposure to the same or similar unkept playgrounds. Since human cases have been traced to include contaminated home environment and public parks and playgrounds (Schantz & Glickman, 1979), the occurrence of VLM in some of the volunteers could be blamed on their possible routine contact with the contaminated unfenced playgrounds at Bodija and Ijokodo areas, which incidentally serve as their improvised football pitches. There are abundant evidence in this study to incriminate the two unfenced playgrounds for the VLM detected in some of the volunteers. Firstly, these were the only 2 of the 5 playgrounds that had enough viable and developing eggs to infect humans (above 2.1 eggs per 5.0gm of soil, Woodruff *et al.* (1981). Secondly, both were the unfenced of the 5 lots, a situation that admits more stray and ownerless dogs to enter there to eat fresh bones from the adjoining slaughter slabs, thereby contaminate its soil. Thirdly, a sizable percentage of the VLM+ group of volunteers had their schools around Bodija and Ijokodo playgrounds. It seems probable that the higher number of eggs per soil sample from these playgrounds was facilitated by the fact of their fencelessness to curtain dog's entrance. Good maintenance of public parks, playgrounds, gardens, which includes fencing that denies ownerless dogs access, has been reported as a very effective measure of reducing the level of soil contamination by toxocara ova in some other urban cities of the world, (Abo-Shehada, 1989; Ludlam & Platt, 1989; Ajayi & Duhlinska, 1998), Nigeria cannot be an exception.

Due to the public health importance of both VLM and OLM, especially the possible visual impairment and other neuropsychological implications (Marmor *et al.,* 1987), efforts are being intensified globally to stem down its tide, such include (a) the development of more sensitive and specific serodiagnostic tests as tools for clinical and epidemiological studies (b) the recognition of the expanded role of veterinarians and the veterinary profession in disease prevention. According to Schantz & Glickman (1979) the veterinarian's role in the prevention of both canine and human toxocariosis should be directed at;

- Keeping the number of uncontrolled, ownerless dogs and cats as well as unwanted or poorly supervised homeless pets very low.
- Preventing fouling of pavements and public places with dog faeces, and excluding dogs from children playgrounds and areas of parks by proper fencing.
- Periodic oral treatment of pupils in schools and their formal education on the need for a good personal hygiene, especially in the Tropical and subtropical countries where sandboxes are not in common use.
- Enforcing the leash laws and promoting the social concept of responsible pet ownership.
- Educating the public, particularly pet owners, concerning zoonotic disease risks and particularly of *T. canis*. The special risks in the childhood unhygienic habits of nail biting and thump sucking that promote geophagia should be emphasized.
- Eliminating roundworms from dog by appropriate preventive treatment; possibility with larvicidal drugs.
- Occasional flushing of kennel floors with hot brine which has been reported as effective in controlling nematodes infections (Woodruff *et al.,* 1984).

Given proper funding and encouragement, the control of toxocariosis by vaccination can be a reality in the foreseeable future in Nigeria, just as it is in most South American countries (Barriga, 1991).

References

Abo-Shehada MN (1989). Prevalence of Toxocara ova in some schools and public grounds in Northern and Central Jordan. *Annals of Tropical Medicine and Parasitology,* **83**(1): 73 -75.

Ajayi OO, Duhlinska DD, Agwale SM & Njoku M (2000). Frequency of human toxocariasis in Jos, Plateau state, Nigeria. *Memórias do Instituto Oswaldo Cruz,* **95** (2): 147-149.

Ajayi OO & Duhlinska DD (1998). Distribution of toxocara eggs in Jos and Dutse- Kura, Plateau State, Nigeria. *Science Forum* **1**(1): 31-37.

Barriga OO (1988). A critical look at the importance, prevalence and control of toxocariasis and the possibilities of immunological control. *Veterinary Parasitology,* **29** (2-3): 195-234.

Barriga OO (1991). Rational control of canine toxocariasis by the veterinary practitioners. *Journal American Veterinary Medical Association,* **198** (2)**:** 216-221.

Bass JL, Mehta KA & Glickman LT (1983). Clinically in apparent Toxocara infection in children. *New England. Journal of Medicine,* **308**(12): 723-724.

Becroft DMD (1964). Infection by the dog roundworm, *Toxocara canis*, and fatal myocarditis. *New Zealand Medical Journal*, **63**(3): 729-732.

Burke T & Roberson EL (1983). Fenbendazole treatment of pregnant bitches to reduce prenatal and lactogenic infection of *Toxocara canis* and *Ancyclostoma caninum* in pups. *Journal of American Veterinary Medical Association*, **183**(9): 987-990.

De Savigny DH (1975). *In vitro* maintenance of *Toxocara canis* larvae and a simple method for the production of *Toxocara* ES antigen for use in serodiagnostic tests for visceral larval migrans. *Journal of Parasitology,* **61**(4): 781-782

De Savigny DH, Voller A & Woodruff AW (1979). Toxocariasis: Serological diagnosis by enzyme immunoassay. *Journal of Clinical Pathology,* **32**(3): 284-288.

Duguid IM. (1961). Features of ocular infestation by *Toxocara canis. Ophthalmology*, **45** (12): 789-796.

Glickman LT, Schantz P, Dormbroski R & Cypess RH (1978). Evaluation of serodiagnostic tests for viscera larva migrans. *American Journal of Tropical Medicine and Hygiene,* **27** (3): 492-498.

Glickman LT, Schantz PM & Cypess RH (1979). Canine and human toxocariasis- review of transmission, pathogenesis and clinical diseases .*Journal of American Veterinary Medical Association*, **175** (12): 1265-1269.

Glickman LT & Schantz PM (1981). Epidemiology and pathogenesis of zoonotic toxocariasis. *Epidemiological Review,* **3**(3): 230-250.

Holland CV, O'Lorcain P, Tailor, MR & Kelly A (1995). Seroepidemiology of toxocariasis in school children.*Parasitology,* **110** (Pt 5): 535-545.

Huntley CC, Costas MC & Lyerley A (1965). Visceral larva migrans syndrome: Clinical Characteristics and Immunologic studies in 51 patients. *Pediatrics*, **36** (4): 523-536.

Lloyd S (1998). Toxocariasis: In: Zoonoses, Eds. S. Palmer, Lord Soulsby, D. Simpson, Oxford Medical Publications, Oxford, England. Pp 841-854.

Ludlam KE & Platt TR (1989). The relationship of park maintenance and accessibility to dogs to the presence of Toxocara spp ova in the soil. *American Journal of Public Health,***79** (5): 633- 634.

MAFF (1986). Manual of Veterinary Parasitological Laboratory Techniques. Reference Book 418, third edition, HM80, London. Pp160.

Marmor M, Glickman LT, Shofer F, Faich LA, Rosenberg C, Cornblatt B & Friedman S (1987).*Toxocara canis* epidemiologic and neuropsychologic findings. *American Journal of Public Health,* **77** (5): 554- 559.

Moore MT (1962). Human *Toxocara canis* encephalitis with lead encephalopathy. *Journal of*

Neuropathology and Experimental. Neurology, **21**(3): 201-218.

Oduye OO (1978). Haematological studies on clinically normal dogs in Nigeria. *Journal of Veterinary Medicine Series A,* **25** (2): 548-555.

Quinn R, Smith HV, Bruce R & Girdwood RWA (1980). Studies on the incidence of *Toxocara* and *Toxoascaris* spp. Ova in the environment (1). A comparison of flotation procedures for recovering *Toxocara* spp. Ova from soil. *Journal of Hygiene*, **84** (1): 83-89.

Schalm DW, Jain NC & Carroll EJ (1975). *Veterinary Haematology,* third edition, Lea and Febiger, Philadelphia. Pp 97.

Schantz PM & Glickman T (1979). Canine and human toxocariasis: the public health problem and the veterinarian's role in prevention. *Journal of AmericanVeterinary Medical Association*, **175** (12): 1270-1273.

Shrand H (1964). Visceral larva migrans: *Toxocara canis* infection, *Lancet.*,**1** (7347) **:**1357-1360.

Snow KR, Ball SJ & Bewick JA (1987). Prevalence of Toxocara species eggs in the soil of five East London parks. *Veterinary Record*, **120** (3): 66-67.

Thompson DE, Bundy DAP, Cooper ES & Schantz PM (1986). Epidemiological characteristics of *Toxocara canis* zoonotic infection of children in a Caribbean community. *Bulletin of World Health Organization*, **64** (2): 283-290.

Urquart GM, Armour J, Duncan JL, Dunn AM & Jennings C (1996). Veterinary helminthology. In *Veterinary Parasitology*, 2nd ed. Book Power, London. Pp 69-71.

Voller A, Bidwell DE & Barlett A (1976b). Microplate enzyme immunoassay for the immunodiagnosis of virus infection.

Manual of clinical immunology. (Rose NR & Friedman H, editors). *American Society for Microbiology,* Washington, DC. Pp 506-512.

WHO (1978). Action to reduce human health hazards arising from animals. *World Health Organization Chronicles*, **32**(8): 307-310.

WHO (World Health Organization) (2002). Reducing risk, promoting healthy life. *The World Health Report*, 2002. Pp 57.

WHO (World Health Organization) (1994). *EPI INFO 6 version. October 1994, Switzerland, Geneva.*

Wiseman RA & Woodruff AW (1971). Toxocariasis in Africa and Malta. *Transactions of Royal Society of Tropical Medicine and Hygiene,* **65** (4): 439-449.

Wolfe A & Wright I.P. (2003).Human Toxocariasis and direct contact with dogs. *Veterinary Record*, **152** (14): 419-422.

Woodruff AW, Bisseru UB & Bowe JC (1966). Infection with animal helminthes as a factor causing poliomyelitis and epilepsy. *British Medical Journal,* **1** (5503): 1576-1579.

Woodruff AW (1976). Toxocariasis as a public health problem. *Environmental Health.* **84** (3)**:** 29-31.

Woodruff AW, Watson J, Shikara I, Al Azzi NS, Al Hadithi TS, Al Adhami SB & Woodruff PW (1981). Toxocara ova in soil in the Mosul District, Iraq, and their relevance to public measures in the Middle East. *Annals of Tropical Medicine and Parasitology,* **75** (5)**:** 555-557.

Woodruff AW (1984). Toxocariasis. *Medicine International,* **2**(2)**:** 206-209.