Intestinal helminthiasis in children with chronic neurological disorders in Benin City, Nigeria: intensity and behavioral risk factors

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Original article

Background: **Behavioral aberrations such as nail biting, finger sucking, and pica have been postulated as risk factors that enhance helminths ova transmission. These aberrations may present commonly in children with chronic neurological disorders and predispose them to heavy intensity of intestinal helminthiasis. This comparative cross-sectional study was to determine the prevalence, intensity, and behavioral risk factors for intestinal helminthiasis in children with chronic neurological disorders and apparently healthy controls.**

Methods: **Fresh stool samples from 155 children (2-17 years) with chronic neurological disorders seen at the child neurology clinic and 155 age and sex matched controls from nursery and primary schools in Benin City were analyzed using the Kato-Katz technique for detection of ova of helminths from November 2008 to April 2009.**

Results: **The prevalence of intestinal helminthiasis (31.0%) was significantly higher in children with chronic neurological disorders compared with the controls (19.4%) (*P*=0.03). The intensity of infections in both groups was light ranging 24-144 eggs per gram. *Ascaris lumbricoides, Trichuris trichiura* and hookworm were the intestinal helminths isolated in both groups. Behavioral aberrations were significantly more represented in the subjects than in the controls (*P*<0.0001, OR=2.8). Nail biting and encopresis were the most significant independent predictors of intestinal helminthiasis (*P*=0.025 and 0.001, respectively) in the subjects only. Hand washing with water and soap after defecation and frequent de-worming exercise were practices significantly associated with decreased prevalence of intestinal helminthiasis in the subjects and controls.**

Conclusions: **Behavioral modification in children with chronic neurological disorders should be an integral part of the control program for intestinal helminthiasis.**

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Key words: **encopresis; helminthiasis; intensity; risk**

Introduction

Intestinal helminthiasis remains one of the world's major neglected tropical disease affecting more than one billion people in the world.[1,2] In Nigeria, the prevalence ranges from 14.4% to 71.1%, depending on the location and the method of helminths detection employed in the study.[3-6] Pre-school and school aged children often present with heavy intensity of infection.[2-4] Children with chronic neurological disorders (CND) are also known to have a high prevalence of intestinal helminthiasis,[7-9] and may stand a greater risk of impaired physical and intellectual development from both their underlying disorders and from heavy helminthic infections.[8-10]

Major contributors to the high burden of intestinal helminthiasis include poverty, poor environmental sanitation, personal hygiene, lack of potable drinking water, and inadequate health care which characterize most communities in developing countries including Nigeria.[3-6] Some behavioral aberrations such as nail biting, finger sucking, encopresis, and pica observed in some children have been postulated as important risk factors that may encourage soil contamination by helminths ova and intestinal helminths transmission

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from one individual to another.[7-11] In a study[7] carried out in 1997 to determine the prevalence of intestinal parasitic infections in the residents of four Italian psychiatric institutions, it was observed that a higher prevalence of intestinal helminths was significantly related to behavioral aberrations such as pica (geophagia, phytophagy, and coprophagy). Herrstrom et al[12] observed that finger sucking, nail biting and pica were strongly associated with *Enterobius vermicularis* infection in healthy children (4-10 years). The authors concluded that finger nail trimming should be considered when treating infected children and especially those with relapsing symptoms.[12]

Available data showed that there is a significant relationship between these behaviors and intestinal helminthiasis.[7,8,12] However, whether or not these behavioral aberrations are more represented in children with CND and whether children with CND could have increased risk of intestinal helminthic infection when compared with their apparently healthy counterparts remain unclear. To provide more information on the above hypothesis, the presence of behavioral aberration (such as finger sucking, nail biting, pica and encopresis) and their association with intestinal helminthic infection were evaluated in children with CND and apparently healthy age and sex matched controls. The intensity of intestinal helminthic infections and possible risk factors for helminthic infections were evaluated in both groups of children.

Methods

This was a comparative cross-sectional study carried out from November 2008 to April 2009. Ethical approval was obtained from the Ethics and Research Committee University of Benin Teaching Hospital, Benin City, Nigeria. In addition, a written permission was obtained from the District Education Authority and verbal permission from the heads of the selected schools for recruitment of the controls. Meetings were held with the heads of the selected schools and representatives of the parents to explain the study. For the subjects, the study was explained to the parents/guardian during the child neurology clinic visits. An informed written consent was signed by each parent/guardian and assent obtained was from older children for each selected subject and control.

For the purpose of this study, CND included cerebral palsy (CP), epilepsy and mental retardation (MR).[13] Diagnostic criteria for the CND were based on the Diagnostic Statistical Manual (DSM) IV (American Psychiatric Association, 1994).[14]

Estimated total population of children with CND seen at the child neurology clinic, University of Benin Teaching Hospital (UBTH), Benin City in a ten year review was 997.[13] The formula for determination of sample size for a study population that is less than 10 000 was therefore used for this study[15] using 95% confidence level and an attrition of 10.0%. The proportion (p) in the targeted population estimated to have intestinal helminthic infections was 88.0% as observed by Garrison et al.[16] The sample size calculated from the above schema was 153. However, a total of 155 children from the child neurology clinic who had accurate and appropriate data were recruited in a simple random manner as they visited the clinic on each clinic day for this study.

The control group was made up of age and sex matched children recruited from public (government owned) nursery and primary schools in Egor Local District, Benin City using a multi-staged sampling technique as follows. There were 34 registered public (government owned schools) primary schools, of which 12 had both primary and nursery schools in the district. List of all the public nursery and primary schools in the metropolis was obtained from the Local Government Education Authority. Thirty percent of the public primary schools, which have nursery schools and were equal to four schools, were selected using a simple random sampling technique of balloting.[17] The selected four schools were allotted alphabets A to D. The total population of each of the four schools was: A=490, B=678, C=733, D=465 while the sum total of all the 4 schools was 2366. The number of pupils selected from each school was determined by using a sampling fraction which was obtained by dividing the sample size (which was 155 obtained for subjects) by the total population of the 4 schools selected (2366) that is 155/2366. This gave a sampling fraction of 0.066. By multiplying the sampling fraction with the population of each school, the number of pupils selected for each school was obtained.

Male to female ratio (1.5:1) was then used to select each pupil from each school according to age strata obtained in the subjects, but each pupil selected from each class was sex matched as the subject. The class in each school from which the pupils were selected was determined by simple random sampling technique. The class register served as sample frame from which each pupil was selected also by the simple random sampling technique.

Children who had taken anthelminthic drug(s) within 3 months preceding the study were excluded. The children who were younger than 2 years old were also excluded. This was because the diagnostic tool and criteria for diagnosis of CND and the behavioral aberration studied were not applicable to children younger than 2 years.[14]

Socio-economic class was determined for each recruited child (subjects and controls) using the method described by Oyedeji.[18]

The procedure of stool collection with a wooden stick was clearly explained to each parent/guardian of the participants (subjects and controls). They were then requested to bring morning stool sample as soon as they were passed to the neurology clinic (for subjects) and to school (for control).[19] The researchers and research assistants were available to collect the stool samples from the parents.

The stool samples were examined the same day using the Kato-Katz method in the Research Laboratory, Department of Child Health, University of Benin Teaching Hospital, Benin City. The number of eggs per gram of feces was calculated as stipulated by the WHO in 1998.[19] In order to ensure proper identification of hookworm ova, the preparation of each stool slide was read not later than 4-6 hours after taking the samples.[19,20] All the slides were read by one medical microbiologist specialized in parasitology and consistency of the readings was assured by second readings performed on 20.0% of the slides which were randomly selected. Another reading was done after 24 hours for search for ova of *Schistosoma mansoni*.[19,21] The intensity of infections for each worm was defined according to the thresholds proposed by the WHO Expert Committee in 1987.[20]

Data analysis

The data obtained were entered into a Microsoft Excel 2007 spread sheet and the analysis was done using the Statistical Package for Social Sciences (SPSS) version 13.0 (SPSS Inc Chicago, Illinois, USA). Prevalence, specie-specific prevalence, and intensity of intestinal helminths in both subjects and controls were calculated and comparison was made. Quantitative variables were summarized using means and standard deviations. The significance of association between variables was tested using the Chi-square test and Fisher's exact test where appropriate while Student's t test was used for comparison of means. Multiple logistic regression models with presence of intestinal helminthic ova as the dependent variable among the subjects and controls were used to identify factors that were independent predictors of intestinal helminthiasis in both subjects and controls. The level of significance of each test was set at $P<0.05$.

Results

Totally 155 subjects and 155 age and sex matched controls [93 (60.0%) males and 62 (40.0%) females] whose stool samples were suitable for analysis were recruited for this study. Mean age (±SD) of subjects was 6.0±4.0 years and that of the controls was also 6.0±4.0 years. Of the 155 subjects, 90 (58.1%) had CP, 53 (34.2%) had epilepsy and 12 (7.7%) had MR.

The prevalence of intestinal helminthiasis in children with CND (31.0%) was significantly higher than that (19.4%) in the control group (χ^2=4.95, P=0.03, 95% CI=1.07, 1.67). Intestinal helminthiasis was significantly more common in children with MR (8/12, 66.7%) when compared with those with CP (29/90, 32.2%) and those with epilepsy (11/53, 20.8%) (χ^2=9.81, df=2, P=0.007). Among the subjects, 30 (32.3%) of the 93 males and 18 (29.0%) of the 62 females had intestinal helminthiasis while the corresponding values for the control group were 20 (21.5%) for males and 10 (16.1%) for females. Gender was not significantly associated with intestinal helminthiasis in both subjects and controls (subjects: χ^2=0.06, P=0.80; controls: χ^2=0.39, P=0.53).

Mean age (±SD) in the infected CND group (5.9±3.7 years) was significantly lower (t=2.70, P=0.009) than that in the infected control group (8.6±4.7 years). The peak age-group-specific prevalence in infected subjects was 6-9 years while in infected controls there was an increase in prevalence with age increasing (Table 1).

Two-thirds of the participants (subjects and controls) were from the upper social class while 1/3 of them were from the lower social class. Among the subjects, intestinal helminthiasis was significantly higher among the children from the lower social class (χ^2=6.44, P=0.011, 95% CI=0.20, 0.82). There was no significant difference in social class between the infected and non-infected controls (χ^2=0.001, P=1.00,

Table 1. Age-specific prevalence of intestinal helminthiasis in infected and non-infected subjects and controls

Age (y)	Subjects		Controls		χ^2	P value	95% CL
	Infected (%)	Non-infected (%)	Infected (%)	Non-infected (%)			
2-5 (n=98)	26 (26.5)	72 (73.5)	11 (11.2)	87 (88.8)	6.53	0.01	1.32-6.18
6-9 (n=25)	11 (44.0)	14 (56.0)	5 (20.0)	20 (80.0)	2.30	0.12	0.89-11.07
10-13 (n=23)	9 (39.1)	14 (60.9)	7 (30.4)	16 (69.6)	1.47	0.76	0.43-4.98
14-17 (n=9)	2 (22.2)	7 (77.8)	7 (77.8)	2 (22.2)	*	0.06	0.09-0.75
Total (n=155)	48 (31.0)	107 (69.0)	30 (19.4)	125 (80.6)			

*: Fisher's exact test; CL: confidence level.

95% CI= 0.43, 2.36).

The isolated helminths were *A. lumbricoides* (in 20.0% of the subjects and 15.5% of the controls), *T. trichiura* (in 7.7% of the subjects and 1.9% of the controls) and hookworm (in 7.7% of the subjects and 1.9% of the controls). Hookworm species isolated was *Ancylostoma duodenale* (*A. duodenale*). Mixed infections were observed in 4.5% (7/155) of the subjects and none in the control group. *A. lumbricoides* and hookworm were found in 4 (57.1%) of the 7 subjects with mixed infections, while 2 (28.6%) children had *A. lumbricoides* and *T. trichiura*, and one (14.3%) child had *T. trichiura* and hookworm.

The intensity of infection was light for all species of intestinal helminths in both subjects and controls. Among the subjects, the intensity range for *A. lumbricoides* and *T. trichiura* was 24-96 eggs per gram (epg) while that for hookworm was 24-72 epg. The intensity range for all the mixed infections was 48-72 epg for all the species observed. Among the controls, the intensity range for *A. lumbricoides* was 24-144 epg, hookworm was 24-72 epg, and *T. trichiura* was 48-72 epg. The mean epg was 70.5±27.7 for *A. lumbricoides*, 69.8±36.3 for hookworm, and 65±32.4 for *T. trichiura* in the subjects.

More subjects (93; 60.0%) with behavioral aberrations were observed than in the control group (54/155; 34.8%) (χ^2=18.68, P<0.0001, OR=2.8, 95% CI = 1.77, 4.45). Nail biting 43 (27.7%) was the most common behavioral aberration observed in the subjects. Finger sucking and pica were observed in 24.5% (38/155) of the subjects respectively and encopresis was observed in 22.6% (35/155) of the subjects. Identified behavioral aberrations among the different types of CND are shown in Table 2. Behavioral aberrations were most represented in children with MR compared to CP and epilepsy except encopresis which was more common in CP. Encopresis was not present in any of the controls.

Infected subjects had more behavioral aberrations. More infected subjects (33/48, 68.8%) were observed with behavioral aberration than the infected controls (10/30, 33.3%) and they were about 4 times more likely to acquire intestinal helminthiasis than the controls (χ^2=7.98, P=0.01, OR=4.4, 95% CI = 1.66, 11.66). Encopresis was significantly associated with increased prevalence of intestinal helminthiasis among the subjects (P<0.001, OR=3.7) (Table 3). Multiple logistic regression models of the independent influence of behavioral aberrations (nail biting, finger sucking, encopresis and pica) on intestinal helminthic infections in subjects and controls is shown in Table 4. The model showed that nail biting and encopresis were the most significant independent predictors of intestinal helminthiasis (P=0.025 and 0.001, respectively) in the subjects while none of the behavioral aberrations studied were predictors of intestinal helminthic infection in the control group.

Hand washing after defecation (or after cleaning the child following passage of stool) was practiced by 142/155 (91.6%) of the subjects or their care-givers and 143/155 (92.3%) of the controls or their care-givers. Table 5 shows methods of hand washing practices among the subjects and controls. The subjects and controls who do not wash hands at all after defecation or who wash their hands with water only (or whose care-givers do not wash hands after cleaning the child) significantly had intestinal helminthiasis when compared with those subjects and controls who washed their hands with water and soap.

Overall 130 (83.9%) subjects and 141 (91.0%) controls had received anthelminthic drugs at least once in the preceding one year (but not within 3 months before the study). Intestinal helminthiasis was significantly more common in the subjects 38/48 (79.2%) and controls 20/30 (66.7%) who had never received anthelminthic drugs or who received anthelminthic drugs just once in the preceding one year (subjects: χ^2=8.9, OR=3.5, P=0.0028; controls: χ^2=9.69, OR=4.0, P=0.0019). Administration of anthelminthic drugs every 3 months independently predicted low prevalence of intestinal helminthiasis in both subjects and control groups (Table 4).

Table 3. Behavioural aberration in intestinal helminthiasis infected and non-infected subjects

Behavioral aberration	Infected (n=48) (%)	Non-infected (n=107) (%)	P value	OR	95% CL
Nail biting	17 (35.4)	26 (24.3)	0.22	1.70	0.81-3.58
Finger sucking	15 (31.3)	23 (21.5)	0.19	1.70	0.77-3.57
Encopresis	19 (39.6)	16 (15.0)	0.01	3.70	1.70-8.18
Pica	13 (27.1)	25 (23.4)	0.77	1.20	0.56-2.65

OR: odds ratio; CL: confidence level.

Table 2. Types of chronic neurological disorders and behavioral aberration in subjects with intestinal helminthiasis

Behavioral aberration	Cerebral palsy (N=90)		Epilepsy (N=53)		Mental retardation (N=12)	
	Infected (n=29)	Non-infected (n=61)	Infected (n=11)	Non-infected (n=42)	Infected (n=8)	Non-infected (n=4)
Nail biting	9 (31.0)	9 (14.8)	5 (45.5)	13 (30.9)	3 (37.5)	4 (100.0)
Finger sucking	10 (34.5)	15 (24.6)	1 (9.1)	7 (16.7)	4 (50.0)	1 (25.0)
Encopresis	14 (48.3)	13 (21.3)	3 (27.3)	3 (7.1)	2 (25.0)	0 (0.0)
Pica	8 (27.6)	19 (31.1)	2 (18.2)	5 (11.9)	3 (37.5)	1 (25.0)

Table 4. Multiple logistic regression models of behavioral aberration, de-worming exercise, and social class with intestinal helminthic infections in subjects and controls

	β	SE	χ^2	Exp (β)	*P* value
Subjects					
Behavioral aberration					
Nail biting	1.08	0.48	5.02	2.95	0.025
Finger sucking	0.04	0.50	0.01	1.04	0.930
Encopresis	1.71	0.50	11.80	5.51	0.001
Pica	0.31	0.48	0.40	1.36	0.527
De-worming exercise					
Anthelminths 'received or 'not'	19.54	0.68	828.21	3.07	0.000
Every 3 mon	-18.15	0.59	952.11	1.32	0.000
Every 4 mon	-16.78	0.83	406.82	5.14	0.000
Every 6 mon	-18.17	0.00	0.00	1.29	0.000
Social class	-0.95	0.42	5.04	0.39	0.025
Intercept	-2.49	0.90	7.87	0.00	0.005
Controls					
Behavioral aberration					
Nail biting	0.05	0.57	0.01	1.05	0.933
Finger sucking	0.17	0.65	0.07	1.18	0.796
Encopresis	0.00	0.00	0.00	0.00	0.000
Pica	-0.49	0.71	0.48	0.61	0.487
De-worming exercise					
Anthelminths 'received or 'not'	2.05	0.82	6.18	7.74	0.013
Every 3 mon	-1.37	0.69	3.98	0.26	0.046
Every 4 mon	-0.32	0.82	0.15	0.73	0.696
Every 6 mon	-0.10	0.86	0.01	0.91	0.908
Social class	-0.09	0.47	0.04	0.37	0.843
Intercept	0.50	1.05	0.23	0.00	0.628

SE: standard error; β: measure of how strongly each predictor variable influences the outcome variables; Exp (β): exponential (β).

Table 5. Methods of hand washing versus intestinal helminthiasis in subjects and controls

Method of hand washing	Subjects		Control group	
	Infected (%)	Non-infected (%)	Infected (%)	Non-infected (%)
Water and soap	11 (22.9)	82 (76.6)	12 (40.0)	100 (80.0)
Water only	32 (66.7)	17 (15.9)	13 (43.3)	18 (14.4)
No hand washing	5 (10.4)	8 (7.5)	5 (16.7)	7 (5.6)
Total (*n*=155)	48 (100.0)	107 (100.0)	30 (100.0)	125 (100.0)

For subjects: χ^2=43.31; *df* =2; *P*<0.001. For controls: χ^2=19.31; *df* =2; *P*<0.001.

Discussion

A. lumbricoides, *T. trichiura*, and *A. duodenale* were the intestinal helminths species isolated from the subjects and controls in this study. Light intensity of intestinal helminthic infections observed in the control group is consistent with the findings in some previous studies among children 0-15 years old in Benin City, Edo State[5,22] and Ethiope,[23] Delta State of Nigeria. Unexpectedly, the children with CND in this study also had light intensity of intestinal helminthiasis. The frequent visits of these children to health facilities could have exposed them to better health care.[13] This study was hospital based and the subjects were children on regular follow-up in the child neurology clinic. During clinic visits their care-givers could have been taught of behavioral practices for prevention of certain childhood disease including intestinal helminthiasis. It could have also been possible that de-worming exercise constituted part of the health care provided during such clinic visits since about 83.9% had received anthelminthic drug at least once in the preceding one year before this study.

Infection rates for intestinal helminthiasis were significantly associated with the frequency of de-worming exercises per year in both subjects and controls. The more frequent a child is de-wormed, the less likely the child would have intestinal helminthiasis. This observation is in tandem with that of Lormans et al[24] in 1975 on 150 institutionalized mentally ill patients aged 5-25 years. The authors noted a reduction in the prevalence of intestinal helminthiasis (*Enterobius vermicularis*) from 62.7% to zero percent following an anthelminthic program. In Nigeria, Oyewole et al[25] in 2002 observed a reduction in intestinal helminthiasis from 84.0% to 41.7% after two weeks of administration of 200 mg of mebendazole to their study subjects (primary school children in Riverine communities of Ondo State, Nigeria). The authors emphasized community mobilization program in educating parents and pupils on the overall benefits of regular de-worming exercise.

Behavioral aberrations observed in this study (finger sucking, nail biting, encopresis and pica) were more significantly represented in children with CND than in the control group (*P*<0.0001). This shows that behavioral aberrations perhaps are more common in children with CND than in apparent healthy children. These behavioral aberrations pose a higher risk of intestinal helminthic infection in children with CND as observed in this study (OR=4.4). Some authors have identified pica (corprophagy, geophagy and phytophagy) as a major predictor of intestinal helminthiasis in children with CND.[7,8] In this study, encopresis and nail biting were significant predictors of intestinal helminthiasis among the children with CND. Encopresis and poor sanitary condition have been observed as major sources of soil contamination with ova of helminths.[11] Intestinal helminths can then be acquired by ingestion of soil contaminated with helminths ova as has been observed in children with pica (geophagy).[7,8] Contaminated soil can lodge under the nails and the disease can then be acquired during nail biting and finger sucking.[8-11] Encopresis and nail biting observed in children with CND could be the reasons for the higher prevalence of intestinal helminthiasis than in the healthy controls.

Hand washing after defecation has been identified as an effective preventive measure for intestinal helminthiasis.[11,22] Children who washed their hands with water and soap (or those whose care-givers do so) after using the toilet/cleaning had a lower prevalence of intestinal helminthic infections when compared with those who washed their hands with water only or who do not wash their hands at all. This finding is in consonance with that reported in 2008.[22] This observation perhaps attests to the efficacy of soap as an important agent in hand washing practices of individuals against intestinal helminths ova.[11]

In conclusion, encopresis and nail biting are significant predictors of intestinal helminthiasis in children with CND. Behavioral modifications and good housekeeping including nail trimming and hand washing with water and soap could serve as means of reducing intestinal helminthic infections in children with CND.

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