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Prevalence of intestinal helminthiasis in children with chronic neurological disorders in Benin city, Nigeria

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Abstract *Background:* It is envisaged that the care for the child with chronic neurological disorder (CND) compared with his apparently healthy counter-part may be sub-optimal, predisposing him to increase disease morbidities including intestinal helminthiasis. To evaluate this hypothesis, a comparative cross sectional study was carried out to determine the prevalence, intensity, and specie-specific prevalence of intestinal helminthiasis in children with CND such as cerebral palsy, epilepsy, and mental retardation seen at the University of Benin Teaching Hospital, Benin City between November 2008 and April 2009.

Subjects and Methods: Fresh stool samples from 155 children with CND and from 155 age and sex matched apparently healthy nursery and primary school children in Benin City, Edo State were analysed using the Kato-Katz technique for the detection of ova of helminths.

Results: The prevalence of intestinal helminthiasis in children with CND was 31.0% compared with 19.4% found among the apparently healthy controls (p = 0.03). This prevalence increased with increasing age in both subjects and comparative group. Intensity of infections in both groups was light. *Ascaris lumbricoides*, *Trichuris trichiura* and *Ancylostoma duedenale* were the intestinal helminths isolated in both subjects and control groups. *A. lumbricoides* alone had the highest specie-specific prevalence in both the subjects (20.0%) and comparative groups (15.5%). Mixed infection was found only among the children with CND.

Conclusion: Intestinal helminthiasis is common and more prevalent in children with CND than in healthy children. It is recommended that regular de-worming be incorporated into the routine care of children with CND.

Key words: chronic neurological disorders, helminthiasis, intestinal helminths, intensity

Introduction

Intestinal helminths are groups of parasites which live and feed on living hosts, receiving nourishment and protection while disrupting the hosts' nutrient absorption, causing weakness and diseases.[1] It is estimated that more than one billion people in the world are infected with one or more of these parasites with pre-school and school aged children often presenting with heavy worm infection.[2-4]

Worldwide prevalence of intestinal helminthiasis among school children varies from 8.9% to 89.0%.[3] In Nigeria, the prevalence ranges from 14.4% to 71.1%, depending on location and methodology employed in the study.[4-7]

Major risk factors for high levels of intestinal helminthiasis still remain poverty, poor environmental sanitation, personal hygiene, lack of potable drinking water, inadequate health care, over-crowding and poor health education which characterise most communities in developing countries including Nigeria.[3-7]

Children with chronic neurological disorders (CND) have been found to have sub-optimal care when compared with the apparently healthy children perhaps due to stress of taking care of them and socio-economic implications on the care-givers.[8,9] Coupled with already outlined risk factors, these children may be predisposed to increased intestinal helminthic infections and may stand a greater risk of impaired physical and intellectual development from both their underlying disorders and from heavy helminthic infections.[10,11]

Available published data show varying ranges of prevalence of intestinal helminthiasis in children with CND.[12-15] A prevalence of 88.0% was observed among children aged 3-14 years with CND (CP, MR, and epilepsy) in Mississippi, USA,[12] while a prevalence of 76.6% was recorded in a 1998 study of parasitic infections among adolescents with MR, in Egypt.[14] These data did not compare the prevalence of intestinal helminthiasis with those obtained from apparently healthy children. Thus it is not clear whether or not there is a higher prevalence of intestinal helminthiasis in children with CND when compared with apparently healthy children within the same locality.

A large number of children suffer from CND.[8,9] If indeed these children are at increased risk of intestinal helminths not only are they at risk for more morbidity from the helminths, but they also serve as sources for dissemination of helminths to members of their communities. This study therefore sets out to evaluate the prevalence, specie-specific prevalence and intensity of intestinal helminthiasis in children with CND compared with apparently healthy age and sex matched control group.

Subjects and Methods

This was a comparative cross-sectional study. Children aged 2-17 years with CND on follow-up in the child neurology clinic, University of Benin Teaching Hospital (UBTH), Benin City were recruited consecutively. Age and sex matched apparently healthy children (control group) were recruited from registered public nursery and primary schools in Benin City using multistage sampling technique.

The study was carried out between 1st November 2008 and 30th April 2009. Ethical approval was obtained from the Ethics and Research Committee of UBTH, Benin City.

For the purpose of this study, CND included cerebral palsy (CP), epilepsy and mental retardation (MR).[8] The diagnostic criteria for the CND was based on the Diagnostic Statistical Manual (DSM) IV (American Psychiatric Association, 1994).[16]

Children who had been known to have taken anthelminthic drug(s) in the preceeding 3 months were excluded. Children who were younger than two years old were also excluded. This was because the diagnostic tool and criteria for diagnosis of CND studied were not applicable to children less than two years.[16,17]

Fresh stool sample, collected in the mornings from subjects and controls were examined the same day with the Kato-Katz method[18] in Research Laboratory, Department of Child Health, University of Benin Teaching Hospital, Benin City. Stool samples passed over night were stored in a temperature of 4^{o}C (which is the temperature of conventional refrigerator) up to the morning and it was then analysed.[18] Such stool sample can be analysed at least 24 hours after the stool sample was collected.[18,19] 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 stool slides were prepared and read by the researchers assisted by medical microbiologist specialised in parasitology. Consistency of the readings was assured by second readings performed in 20.0% of the slides randomly selected. Another reading was done after 24 hours for search for ova of *Schistosoma mansoni*.[19,20] Intensity of infections for each worm was defined according to the thresholds proposed by the WHO Expert Committee in 1987.[19]

Data analysis

The data obtained was entered into a spread sheet using the Microsoft Excel 2007 and the analysis was done using the Statistical Package for Social Sciences (SPSS) version 13.0 (SPSS Inc Chicago, Illinois, USA). The overall prevalence, specie-specific prevalence, and intensity of intestinal helminths in both the subjects and the control group were calculated and comparison made. Social class of both subjects and comparative group was done as documented by Oyedeji.[21] Quantitative variables were summarized using means and standard deviations. Frequency tables, graphs and charts were constructed as appropriate. The significance of association between variables was tested using chi-square and Fisher's exact tests where appropriate for comparison of proportions while student t-test was used for comparison of means. The level of significance of each test was set at $p < 0.05$.

Results

There were 155 subjects and 155 age/sex matched control group whose stool samples were suitable for analysis. These consisted of 93(60.0%) males and 62(40.0%) females; mean age 5.6 years ± 3.8 years. Of the 155 subjects, 90(58.1%) had CP, 53(34.2%) had epilepsy and 12(7.7%) had MR. One hundred and three (66.5%) of the subjects belonged to the upper social class and 52(33.5%), lower social class. There was no statistical significant difference in the social class status of subjects and the apparently healthy group (χ^2 = 0.00, p = 1.00, 95%C.I = 0.62-1.60, OR = 1.00). Table 1 shows the socio-demographic characteristics of the subjects and the control group in relation to gender.

Table 1: Socio-demographic characteristics of subjects and controls

Socio-demographic characteristics	Subjects Male n(%)	Subjects Female n(%)	Controls Male n(%)	Controls Female n(%)
Age Group (Years)				
2-5	59(63.4)	39(62.9)	59(63.4)	39(62.9)
6-9	13(14.0)	12(19.4)	13(14.0)	12(19.4)
10-13	14(15.1)	9(14.5)	14(15.1)	9(14.5)
14-17	7(7.5)	2(3.2)	7(7.5)	2(3.2)
Total	93(100.0)	62(100.0)	93(100.0)	62(100.0)
Social class				
Upper	61(65.6)	42(67.7)	59(63.4)	44(71.0)
Lower	32(34.4)	20(32.3)	34(36.6)	18(29.0)
Total	93(100.0)	62(100.0)	93(100.0)	62(100.0)
	χ^2=0.01, p=0.92, OR=0.9		χ^2=0.64, p=0.42, OR=0.7	

Table 2: shows the socio-demographic characteristics of the different types of CND. Half of the children with MR belonged to the lower social class. All subjects and the control group were living with their parents or care-giver.

Socio-demographic features	Cerebral palsy n=90 (%)	Epilepsy n = 53 (%)	Mental Retardation n= 12 (%)
Gender			
Male	48(53.3)	38(71.7)	7(58.3)
Female	42(46.7)	15(28.3)	5(41.7)
Age (years)			
2-5	73(81.1)	25(47.2)	0(0.0)
6-9	11(12.2)	10(18.9)	4(33.3)
10-13	5(5.6)	12(22.6)	6(50.0)
14-17	1(1.1)	6(11.3)	2(16.7)
Social class			
Upper	64(71.1)	33(62.3)	6(50.0)
Lower	26(28.9)	20(37.7)	6(50.0)

The prevalence of intestinal helminthiasis in children with CND (31.0%) was significantly higher than the 19.4% observed in control group (χ^2 = 4.95, p = 0.03, 95%C.I = 1.07-1.67). Among the 90 children with CP, 29(32.2%) had intestinal helminthiasis, 11(20.8%) of the 53 with epilepsy and 8(66.7%) of the 12 with MR had intestinal helminthiasis respectively. There was a significant difference in prevalence of intestinal helminthiasis and type of CND (χ^2=9.81, df=2, p=0.01).

Thirty (32.3%) of the 93 male and 18(29.0%) of the 62 female subjects 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 control group (subjects: χ^2 = 0.06, p = 0.80; control group: χ^2 = 0.39, p = 0.53).

The mean age of 5.9 ± 3.7 years in the infected CND group was significantly lower than the 8.6 ± 4.7 years in the control group (t = 2.70, p = 0.009). Among the age group (2-5 years), the subjects had significantly more intestinal helminthiasis when compared with the controls (χ^2 = 6.53, p = 0.01). The peak age group specific prevalence in infected subjects was 6-9 years, 11/25(44.0%); and thereafter a decline in prevalence was observed with increasing age. In infected controls, there was increase in prevalence with increasing age (Table3).

Table 3: Age-specific prevalence of infected and non-infected subjects and control group

Age (Years)	Subjects Infected (%)	Subjects Not infected (%)	Control group Infected (%)	Control group Not infected (%)	χ^2	p–value	95%C.I
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, C.I = Confidence interval

Intestinal helminthiasis was significantly higher among the children from the lower social class and these children were three times more likely to acquire intestinal helminthic infection compared to the children from the upper class in both subjects and control group. (χ^2 = 6.39, p = 0.01, 95CI = 1.38-8.04, O.R = 3.3) (Table 4).

Table 4: Social class of infected and non-infected subjects and control group

Social class	Subjects Infected (%)	Subjects Not infected (%)	Control group Infected (%)	Control group Not infected (%)	χ^2	p –value	95%C.I	O.R
Upper (n = 103)	25(24.3)	78(75.7)	20(19.4)	83(80.6)	0.45	0.50	0.68 – 2.59	1.3
Lower (n = 52)	23(44.2)	29(55.8)	10(19.2)	42(80.8)	6.39	0.01	1.38 – 8.04	3.3
Total (n = 155)	48(31.0)	107(69.0)	30(19.4)	125(80.6)				

A *lumbricoides*, T. *trichiura*, and *Ancylstoma* duodenale were the intestinal helminths isolated from both the subjects and control group in this study. Although the species-specific prevalence seemed higher for all 3 helminths among the subjects compared to the control group but the differences were not statistically significant ($\chi^2 = 0.80$, $p = 0.37$). *A. lumbricoides* alone had the highest specie-specific prevalence of 31/155 (20.0%) among the subjects and 24/155(15.5%) among control group, *T. trichiura and A. duodenale* were observed in 12/155(7.7%) subjects respectively while among the control groups; the prevalence was 3/155(1.9%) for both helminths respectively.

Table 5: showed species of intestinal helminths and different types of CND studied. There was no significant association between types of CND and species of intestinal helminths in subjects ($\chi^2 = 8.13$, df = 6, p = 0.23). Mixed infections was observed in 7/155(4.5%) of subjects and were among children with CP. The different combination of mixed infection were *A. lumbricoides and A. duodenale 4/7(57.1%), A. lumbricoides and T. trichiura 2(28.6%) and T. trichiura and A. duodenale* 1 (14.3%). Mixed infection was not observed among the control group.

The intensity of infection was light for all species of intestinal helminths in both subjects and control group.

Table 5: Species of intestinal helminths and types of CNDs

Specie of Intestinal helminths	Cerebral palsy n = 29 (%)	Epilepsy n = 11 (%)	Mental Retardation n = 8 (%)
Ascaris lumbricoides	15(51.7)	7(63.6)	3(37.5)
Trichuris trichiura	4(13.9)	2(18.2)	3(37.5)
Ancylostoma duodenale	3(10.3)	2(18.2)	2(25.0)
Mixed infections	7(24.1)	0(0.0)	0(0.0)

Table 6: shows use of footwear among the different types of CND. Children with CP significantly did not use footwear regularly when compared with the other forms of CND (epilepsy and MR) ($\chi^2 = 8.25$, df = 2, p = 0.016). Of the 29 children with CP who had intestinal helminthiasis, 21(72.4%) did not use footwears regularly. The corresponding values for epilepsy and MR were 5/11(45.5%) and 3/8(37.5%) respectively. All 12 subjects (8 with CP, 2 with epilepsy and 2 with MR) and all three controls that had *A. duodenale* infections; did not use footwear regularly. There was statistically significant association between *A. duodenale* infection and use of footwear in subjects ($p < 0.001$ Fisher's Exact) as well as in controls ($p = 0.04$ Fisher's Exact). All children with CP and who had mixed infections did not use footwear regularly.

Table 6: Use of footwear among the different types of chronic neurologic disorders

Regular use Of footwear	Cerebral palsy (%)	Epilepsy (%)	Mental retardation (%)	Total (%)
Yes	39(43.3)	36(67.9)	7(58.3)	82(52.9)
No	51(56.7)	17(32.1)	5(41.7)	73(47.1)
Total	90(100.0)	53(100.0)	12(100.0)	155(100.0)

$\chi^2 = 8.25$, df = 2, p = 0.016

Discussion

This study revealed a significantly higher prevalence (31.0 %) of intestinal helminthiasis in children with CND (CP, epilepsy, and MR) compared to 19.4% in age and sex matched apparently healthy control group. The prevalence is comparable to finding by Lohiya *et al*[13] who observed a prevalence of 31.0% (for *Enterobius vemicularis* only) in a long term care facility for a population of 997 consisting of both adults and children with epilepsy, cerebral palsy, mental retardation, and autism in New York. This prevalence is however lower than the 88.0% found among children aged 3-11 years with CND in a developmental centre in Mississippi, USA.[12] All subjects in these studies were institutionalised. The lower prevalence in this study may be because all the studied children lived with their parents/care-giver who may have provided them with better care. Reasons proffered for the high prevalence rates in the two studies in USA were poor housekeeping, poor general hygiene, poor toilet facilities, inaccessibility to adequate potable water supply as well as length of year of stay within the institution.

These factors havebeen documented as major risk factors to intestinal helminthiasis and characterise most communities with low socioeconomic status.[10] It was also observed from this study that most infected subjects were from low social class. In fact children from low social class were three times more likely to be infected compared to their counter-part from upper social class. This finding was in consonance with previous findings that lower social economic class is a major contributor to intestinal helminthiasis.[3-7]

Intestinal helminthiasis was more in children with MR compared to those with epilepsy and CP.

Although, the number of children with MR was small, this finding still may suggest that children with MR were at higher risk of acquiring intestinal helminthiasis compared with other types of CND (epilepsy and CP). This is corroborated by other authors who have also found higher prevalences of intestinal helminthiasis in this group.[13,14,22] This higher prevalence could be attributed to underlying impaired neurological dysfunction which is usually more profound in children with MR when compared with those with CP and epilepsy.[11] This profound neurological dysfunction may translate to poor level of care and possible neglect of these children,[8,9,13-15] hence may put them at higher risk of acquiring intestinal helminthiasis when compared with other CNDs (CP and epilepsy).[12-15] The lower intelligence in this group may also be annotated with poorer peri-anal hygiene at an age when they are expected to take care of themselves.

The prevalence figure (19.4%) observed in apparently healthy control group in this study is comparable with previously documented findings in Nigeria.[4-7,23] The present study as in others,[4-7,23] demonstrated no significant gender difference in intestinal helminthic infection in subjects as well as in control group..The study also demonstrated increase in prevalence of intestinal helmitnhiasis with increasing in age in both the children with CND and in apparently healthy children as has been observed by most authors.[3-7,12,13] This could be attributed to sheer stress encountered in care for children with CND. Generally, personal care for children tend to decrease with increase in age as mothers/caregivers pay more attention to the younger children.[8,9] The stress of caring for children with CND as they grow older is enormous.[8,9] Coupled with already compromised neurological status, these children may be predispose to increased intestinal helminthic infections with increase in age.

The species of intestinal helminths isolated in both subjects and control group in this study included *A.* lumbricoides, T. trichiura and A. duodenale. These species were comparable with those observed by some authors in children with CND.[12,13] Ekundayo *et al*[4] (2007) as in this study showed that in over a 30 year period that the triad of *A. lumbricoides*, *T. trichiura* and *A. duodenale* species were the common intestinal helminths isolated among pre-school and school aged children in Nigeria. This indicates that these are predominant helminths in the environment to which both children with CND and their apparently healthy counter-parts are exposed. The prominence of *A. lumbricoides* over the other helminths in this study may be due to embryonated eggs, having enormous capacity to withstand extremes of environmental temperatures.[2,10] Thus within the context of the weather during which the study was carried out (November to April), thriving of the ova of *A. lumbricoide* could be said to be enhanced in comparison with those of *T. trichiura* and *A. duodenale*.

Presence of *A. duodenale* infection is seen as an index of environmental contamination with human waste.[10] These helminths constitute more of the mixed infection observed in this study and were seen only in children with CP. Use of footwear especially while going to farm, schools or at play grounds have been known to be protective against hookworm infections.[5,10] Mixed infections and *A. duodenale* infection occurred significantly more in subjects, as against the apparently healthy comparative group. It was observed in this study that children with CP significantly did not use footwear regularly when compared with children with epilepsy and MR. Some children with CP may not have used footwear and so many others may have been crawling on the ground due to the associated disorder of posture and movement.[8,9]

An ambulatory child who does not use footwear regularly at school or at play ground, or a non-ambulatory child who crawls regularly on the ground is at risk of penetration of hookworm larvae through the skin.[10] And judging by the fact that *A. lumbricoides* and *A. duodenale* were the most prevalent species of helminths in the mixed infection, it could be postulated that poor care (for non-ambulatory children who sit or crawls on the ground regularly) as well as lack of regular use of foot-wear for ambulatory children could have contributed to the mixed infections found among the children with CP.

The intensity of infection in both the CND and apparently healthy group was light, perhaps underscoring the fact that both groups irrespective of primary health conditions are exposed to the same environment and therefore the same range of helminthes. Though one would have expected heavy intensity of intestinal helminthiasis in children with CND, the possible explanation for light intensity among such children and against expectations could be attributed to exposure to regular health care services compared to previous documentations.[8] This study was hospital based, and majority of the subjects were on regular follow-up in child neurology clinic. During such regular follow-up visits, the subjects and their mothers/caregivers could have benefitted from health education which constituted part of such routine clinic visits.

With one in every three children with CND having intestinal helminthiasis, it is recommended that regular de-worming exercise be incorporated into the routine care of children with CND. Special protective footwear and special carrier cot could be made available for children with CP to reduce the risk of hook worm infection.

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