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RESEARCH PAPER

PREVALENCE AND IMPACT OF SOCIO-ECONOMIC/ENVIROMENTAL FACTORS ON SOIL-TRANSMITTED HELMINTH INFECTION IN CHILDREN ATTENDING CLINIC IN A TERTIARY HOSPITAL IN BENIN CITY, NIGERIA

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ABSTRACT

Children are important risk group for soil-transmitted helminths (STH). Hence, this study was undertaken to determine the impact of mothers' educational status, the method of fecal disposal and source of water supply on the prevalence of STH infection. Four hundred and ninety six children, aged 1-15 years, who presented at the Children Out-patient Clinic of the University of Benin Teaching Hospital (UBTH) were screened for STH in their stool, using methods of wet preparation and Stoll's technique for detection and counting of helminthes eggs. A semi-structured, researcher administered questionnaire was used to collect information on socio demographics of mother/care giver, history of de-worming, source of water supply, and method of fecal disposal. The overall prevalence of STH infections was 9.5%, corresponding to 6.9% of *Ascaris lumbricoides*, 2.4% of hookworm and 0.2% of *Trichuris trichiuria*. Infection with hookworm was of highest intensity. Age group 6 - 10 had the highest prevalence of STH. Mother/caregivers level of education, method of faecal disposal and source of water supply, all significantly influenced the prevalence of STH infection. There is need for a coordinated, multi-sectarian and multidisciplinary strategy that integrates periodic deworming, health education and environmental sanitation for effective control.

***Keywords:* Soil-transmitted helminths, Prevalence, Children, Benin City.**

INTRODUCTION

Soil-transmitted helminth (STH) infections are the most common infections worldwide, especially among the poorest and most deprived communities in tropical and subtropical areas, including Sub-sahara Africa (WHO, 2012). STH infections are caused by different species of parasitic worms, especially the triad of roundworm (*Ascaris lumbricoides*), hookworms (*Necator americanus, Ancylostoma duodenale*) and the whipworm (*Tricuris trichiuria*). The normal location of the adult worms is the intestinal lumen of human. They are transmitted by eggs present in human feces which contaminates the soil in area where sanitation is poor. Eggs are ingested from contaminated water, vegetables not properly washed or by children who play in soil and then put their hands in their mouth without washing them. In addition, hookworm eggs hatch in the soil, releasing larva that mature into a form that can actively penetrate the skin, especially among people walking with barefoot. Majority of infected individuals are asymptomatic. Severity of infection may depend on the type and the number of worms harbored. The ranges of symptoms include intestinal manifestation (diarrhoea, abdominal pain, malabsorption, and intestinal obstruction), malnutrition, anaemia, general malaise, weakness, and in children, impaired physical and cognitive development (WHO, 2012; Nokes and Brindy, 1994; Drakes and Bundy, 2001).

According to the WHO (2014), approximately two billion people (about 24% of world population) are affected with STH worldwide. Mortality rate directly due to STH has been estimated at 135,000 deaths annually (Savioli et al., 2004). Children are important risk group and are the worst hit, as infected children are nutritionally, physically and cognitively impaired (Nokes and Brindy, 1994; Savioli et al., 2004). Over 270 million preschool-ages and over 600 million school-age children live in area where these parasites are actively transmitted (WHO, 2014). The quantitative cost of worm infections to cognition and education is enormous. The total lost years of schooling due to worm -associated absenteeism amount to over 200 million years, and almost all these has occurred in low and middle-income countries (WHO, 2014). The average Intelligent Quotient (IQ) loss per worm infection is 3.75 points amounting to IQ loss of 633 million points for the low-income countries (WHO, 2014).

Ekundayo et al. (2007) reported that the prevalence of STH infections in Nigeria between 1977 and 2006 ranges between 1.5% to 88.5% with *Ascaris lumbricoides*, hookworms (*Necator americanus* and *Ancylostoma duodenale*), and *Trichuris trichiuria* species as the commonest agents. Prevalence parameters varied for individual parasites and for rural and urban communities. The high prevalence of STH infections has been closely related with illiteracy, poverty, poor environmental hygiene and impoverished health sector (Ekundayo et al., 2007; Albonico et al., 1999; Wagbatsoma and Aisien, 2005).

Control of STH infections is based on periodic drug treatment (deworming), health education and improved sanitation. The WHO recommends periodic drug treatment, without previous individual diagnosis to all at risk people, especially preschool and school-age children living in endemic areas. The target is to eliminate morbidity due to STH in children by 2020. As at 2012, global coverage of deworming was 32.6% (WHO, 2014).

Data on local prevalence could be useful in understanding the pattern of infections and planning effective control strategy. Thus, the objective of this study was to determine the prevalence of STH infections among children attending clinic at the University of Benin Teaching Hospital and to assess the impact of mothers' educational status and environmental factors.

MATERIAL AND METHODS

Study area and design: This descriptive cross-sectional study was carried out at the University of Benin Teaching Hospital (UBTH). UBTH is located in Benin City, Edo State, Nigeria. Benin City is a cosmopolitan town consisting of three Local Government Areas, bounded in the North East by Ovia East Local Government Area and in the south by Oredo Local Government Area. The climate is hot and humid with rain forest type of vegetation. The hospital has over 700 beds, with out-patient departments, including a pediatric out- patient clinic.

Sample size and sampling technique: Between January and April 2007, a total of 600 children, aged 1-15 years, who presented at the Children Out-patient Clinic of the UBTH were systematically selected for screening for ova of STH in their stool. Each child's mother/caregiver was provided with a clean, dry, leak-proof plastic container marked with a unique identification number. The mothers or caregivers were given instruction on how to collect stool into it and to submit the sample on an arranged day. Only 496 returned with stool specimen and were enrolled for the study.

Data collection and method of stool analysis: Tool for data collection was a semi-structured, researcher administered questionnaire. Information sought in the questionnaire included, socio demographics of mother/caregiver, history of de-worming, source of water supply, and method of faecal disposal. The method of stool analysis employed included a wet preparation with concentration technique using formal-ether, while Stoll's technique was used to determine intensity, as previously published (Cheesebrough, 1998).

Ethical Consideration: Ethical approval was obtained from the Ethical Committee of University of Benin Teaching Hospital. Verbal consent was obtained from each of the parents/caregiver after the purpose of the study had been explained. Confidentiality of participants was ensured throughout the study.

Data analysis: All data obtained from questionnaire forms was entered into a Microsoft Windows version 16.5 data-based statistics program, Statistical Package for Social Sciences (SPSS Inc. Chicago, IL). Descriptive statistics (which included frequency tables) were used to compute percentages and averages. Cross-tabulations were used to examine the relationship between variables (respondents' characteristics and results of specimen analysis). Categorical variables were compared using the Chi-square test, although Fisher's exact test was used when the data was sparse. Tests were two-tailed and a difference of $P<0.05$ was accepted as statistically significant.

RESULTS

The mean age of the children was 4.4 ± 0.6 years with a range between 1 and 15 years. Majority (306; 61.7%), were males and age group 1-5 year was predominant (306; 61.7%) (Table 1). As shown in table 2, a total of 47 (9.5%) respondents had one type of ova or the other in their stool. Thirty four (6.9%) of these were ova of *Ascaris lumbricoides,* 12 (2.4%) were hookworm, while only one (0.2%) was *Trichuris trichiuria.* The mean ova load, calculated as average number of eggs per gram of stool was highest for hookworm (142 ± 67). The single case of *Trichuris trichuria* had 100 ova per gram of stool. For *Ascaris lumbricoides,* the mean ova load was 57 ± 7.6. Majority (205; 41.3%) of the mothers/caregivers completed secondary education; 118 (23.8%) had post secondary education; 87 (17.5%) had primary education; while 41 (8.2%) had no formal education. The prevalence of helminthic infection decreased significantly with increasing educational level of the mother/caregiver ($P < 0.05$).

More than one- half (261; 52.6%) of the respondents use water closet for faecal disposal; 220 (44.4%) used pit latrine, while 15 (3.0%) practice open defecation. The prevalence of helminthic infection was highest among respondents that practiced open defecation compared with those that used water closet and open latrine, and this was found to be statistically significant ($P < 0.05$).

Two third (66.3%) of the respondents relied on vended water as source of water supply; 121 (24.4%) got water from borehole; 31(6.3%) from water board; and 15 (3.0%) from stream. The prevalence of helminthic infection was significantly higher among respondents that relied on stream and vended water than those that sourced water from water board and borehole ($P < 0.05$). When asked of deworming practice, majority (61.7%) of the respondents stated that they had taken one preventive drug (deworming drug) or the other, in the previous 6 months. However, the relationship between deworming practice and prevalence of STH was not statistically significant ($P > 0.05$).

Table 1: Prevalence of STH by sex and age of respondents

Characteristic		Number (%)	Total	p – Value
Sex	**Male**	38 (12.4)	306	
	Female	9 (4.7)	190	< 0.05
Age	**1-5**	24 (7.8)	306	
	6-10	22 (12.6)	175	< 0.05
	11-15	1 (6.7)	15	

Table 2: Prevalence and intensity of STH among respondents

Type	Number (%)	Mean ova count
Ascaris lumbricoides	34 (6.9)	57±7.6
Hookworm	12 (2.4)	142±67
Trichuris trichuria	1 (0.2)	100

Table 3: Educational qualification of mothers/caregivers and helminthic infection among children

Educational qualification	No and % Prevalence of Helminthic Infection	Total	p-value
No formal education	10 (24.4)	41	
Primary	12 (13.7)	87	
Not completed secondary	7 (15.6)	45	< 0.05
Completed secondary	13 (6.3)	205	
Post secondary	5 (4.2)	118	

Table 4: Method of faecal disposal and prevalence of helminthic infection among children

Method	No and % Prevalence of Helminthic Infection	Total	p-value
Open defaecation	6 (40)	15	
Pit latrine	30 (13.6)	220	< 0.05
Water closet	11(4.2)	261	

Table 5: Source of water supply and prevalence of helminthic infection among children

Source	No and % Prevalence of Helminthic Infection	Total	p-value
Water board	1 (3.3)	31	
Bore hole	9 (7.4)	121	< 0.05
Vended water	27 (8.2)	329	
Stream	10 (66.7)	15	

DISCUSSION

The overall prevalence of STH in this study was low and in agreement with previous studies (Ekpenyong and Eyo, 2008; Kattula et al., 2004), but differ from other studies where higher prevalence have been reported (Oninla et al., 2007; Ezeagwuna et al., 2009). The comparatively low prevalence of STH recorded in this study is however, remarkable for an infectious disease. The preponderance of age group 1-5 years (preschool age) among the respondents (61.7%) compared to other studies on school- age children (5-15 years), where higher prevalence have been reported (Oninla et al., 2007; Ezeagwuna et al., 2009; Abossie and Seid, 2014), may account for the low prevalence observed in this study.

The fact that majority (61.7%) of the respondents had taken one preventive treatment (deworming drug) or the other in the previous 6 months, before they were tested, may also explain the low prevalence observed in this study; though the impact of deworming was not found to be statistically significant. Several studies have abundantly demonstrated that periodic deworming is effective in reducing the burden of intestinal helminthiasis (WHO, 2014; Damen et al., 2010). Moreover, this study was carried out in a tertiary hospital setting, located in an urban area (Benin City), where expectedly, mothers are better educated and with better access to clean water and environment compared with their counterpart in rural areas where higher prevalence have been reported (Oninla et al., 2007; Merenukwu et al., 1995).

Nonetheless, the predominant STH found among the respondents was *Ascaris lumbricoides* and is in line with previous findings in Nigeria by Wagbasoma and Aisien (2005) and Ekpenyong and Eyo (2008). This however, differs from other studies where hookworm was found to be of highest prevalence (Ezeagwuna et al., 2009; Damen et al., 2010). The high prevalence of *Ascaris lumbricoides* is due to the direct mode of infection and the high resistance of the infective ova to desiccation which enhances longevity and promotes infectivity. On the other hand, children who play bare-footed on contaminated grounds, commonly in rural areas, are those at risk of infection by hookworm.

Generally, school -age children have been reported to be at greatest risk of STH, because they are highly energetic and continuously exposed to contaminated soil and water (Wagbatsoma and Aisien., 2005; Escobendo et al., 2008). Our findings further buttress this fact. In terms of intensity of infection (defined as the number of eggs per gram of stool) hookworm infection recorded the highest intensity, followed by *Trichuris trichuria* and *Ascaris lumbricoides.* This order is consistent with the report by Britto et al. (2006). The evaluation of intensity of infection using egg count may be an underestimation of the true prevalence of worm infection. For instance, male worms do not produce eggs and also fecal egg counts have been found to vary from day to day (Saka et al., 2006). Nonetheless, in an environment where worm burden is low, prevalence of infection can provide a reasonable estimate of the mean intensity of infection (Saka et al., 2006).

We also observed that majority of the mothers /caregivers were literate; probably due to the fact that this study was urban-based. Women are essentially home managers and notable caregivers in their various families, therefore improved level of mother's education could enhance their chances of providing better healthcare in the home and particularly in influencing the health behavior of their children. This factor may account for the relatively low prevalence of STH recorded in this study; as the prevalence decreased with increasing level of mother or caregivers education. Interestingly, several studies have demonstrated the impact of mother's level of education on prevalence of helminthiasis in children (Okyay et al., 2004; Hual et al., 2012; Ostan et al., 2007).

Globally, helminthic infections are diseases of poverty and underdevelopment. Poor environmental and personal hygiene –with respect to disposal of human feces and hand washing after defecation and before eating, are the driving forces of STH infection. Our study also collaborate several others (Hual et al., 2012; Ilechukwu et al., 2010; Wagbatsoma and Aimiuwu, 2008; Salako, 2001) that demonstrated that the prevalence of helminthic infection is

higher in communities and schools where latrines are lacking or inadequate, and where portable water is scarce or unavailable.

Whereas deworming as prescribed by WHO to be a powerful and cost -effective approach, it remains a short-term strategy due to the possibility of re-infection. It has therefore been recommended that deworming be added to ongoing public health programs such as Integrated Management of Childhood illness, School Health Program, Maternal and Child Health, Roll Back Malaria and Vaccination Program (WHO, 2014). Ultimately, a lasting solution to the burden of STH infection requires improvement in water supply, sanitation and hygiene (Strunz, 2014).

In Nigeria, there is presently no articulated public health policy for the control of STH. We conclude by recommending a multi- sectoral and multi-disciplinary approach, whereby healthcare professionals, educationists and environmental health workers would use the platforms of healthcare facilities, schools and public places to implement periodic deworming of children, promote health education and sanitation.

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AUTHORS CONTRIBUTIONS

Ogbaini-Emovon, E.A. conceptualized the study and wrote the manuscript; Eigbedion, A.O. was involved in data collection and review of manuscript; Ojide, C.K. was involved in data analysis and review of manuscript; Kalu E.I. drafted the Methodology and review of manuscript.