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Research Article

PREVALENCE AND RISK FACTORS ASSOCIATED WITH HELMINTHIC INFECTIONS AMONG PRE-SCHOOL CHILDREN IN KATSINA METROPOLIS, KATSINA STATE, NIGERIA

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ABSTRACT

Intestinal helminth infections are prevalent and a matter of public health concern throughout the developing countries of the world. The present survey was conducted to assess the current prevalence and risk factors of soil-transmitted helminth infections among pre-school children in Katsina metropolis, Katsina state, Nigeria. A total of 302 children, aged 1-5 years, comprising 52.3% females and 47.7% males were involved in the study. Socio-demographic information of the children and their parents were obtained using a pre-tested questionnaire. Stool sample was collected and analyzed using formol-ether concentration technique. The result showed that 60.3% of the children were infected with at least one species of soil-transmitted helminth parasite. *Ascaris lumbricoides* (79.1%) was the most prevalent parasite isolated. It is followed by Hookworm (20.4%) while *Trichuris trichiura* (5.5%) was the least prevalent. Analysis of the possible risk factors associated with the infection among the children showed that, female gender (χ^2 = 6.056; P = 0.014) and age group 4-5 years old (χ^2 = 22.379; P = <0.0001) were among the main risk factors of infection among the study subjects. Other risk factors identified were, Consumption of untreated water (χ^2 = 63.824; P = <0.001) and Geophagy/soil eating (χ^2 = 8.217; P = 0.004). Soil-transmitted helminthiasis is thus a common phenomenon among the pre-school children in the study area. Efforts to improve the health status of the children should include regular monitoring, provision of clean water, deworming and awareness campaigns.

Keywords: Katsina, pre-school children, Parasites, Soil-transmitted helminths.

INTRODUCTION

Intestinal helminth infections are among the most prevalent human parasitic infections and a leading cause of morbidity and mortality worldwide (Mehraj *et al*., 2008). The major causative agents for intestinal parasitism in humans are the triad of soil-transmitted helminths (STHs) including Roundworms (*Ascaris lumbricoides*), Whipworms (*Trichuris trichiura)* and Hookworms (*Ancylostoma duodenale / Necator americanus*) (Aleka *et al*., 2015; Jiero *et al*., 2015). Several authors have recognized STH infections as important health problems especially among children in developing countries (Abdulhamid Ahmed *et al*., 2012;Abdulhamid Ahmed *et al*., 2011; Almegrin, 2015; Bolbol, 1992). STH infections are most common among the inhabitants of the developing countries of the world (WHO, 2012). According to the recent estimates by the World Health Organization, more than 1.5 billion people are infected by helminth parasites globally, leading to severe morbidity and mortality annually, especially in developing countries of the world. Intestinal helminth infections occur in all age groups, however, pre-school children are part of the population with greater risk of morbidity due to infection (Novianty *et al*., 2018; WHO, 2012). Burden of infection by helminth parasites is associated with impaired growth, poor cognitive development, micronutrient deficiency and anaemia which are very detrimental to the wellbeing of the affected individuals (Abdulhamid Ahmed *et al*., 2012; Al-Mekhlafi *et al*., 2007). Children with poor cognitive development normally had difficulties in learning and thereby tend to perform poorly at school and thus may

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fail to reach their potentials in life (Miguel & Kremer, 2004). Similarly, anaemia leads to several other co-morbidities among the affected individuals and may even lead to death(WHO, 2008).

Several epidemiological studies had indicated high prevalence rates of intestinal helminth infections among Nigerian children (Adeyeba & Akinlabi, 2002;Luka *et al*., 2000; Wagbatsoma & Aisien, 2005). Studies had also indicated a direct correlation between the burden of intestinal helminth infections with iron-deficiency anaemia and nutritional deficiencies (Al-Mekhlafi *et al*., 2008) as well as with educational achievement (Shariff *et al*., 2000). An earlier survey by Onadeko & Ladipo, (1989), revealed that majority of Nigerian children from low socio-economic class have been found to be anaemic, stunted with retarded growth and under-weight due to malnutrition. Intestinal worm infections thrive in communities with poor housing plans, poor sanitation, inadequate water supplies, poor health care status, low level of education and low income (Crompton & Whitehead, 1993; Nmorsi *et al*., 2009). In Nigeria, intestinal helminth infections have continued to prevail because of low levels of living standards, poor environmental sanitation and ignorance of simple health-promoting behaviors (Nwosu, 1981). Young children (0-5 years of age) harbor heavy intestinal parasitic infections and thus are a good study group as they constitute the group with high potentials for contaminating the environment and transmitting these infections (Albonico *et al*., 2002). The public health importance of intestinal parasites is due to high morbidity in pre-school and school age children which are the most affected due to the heavy infections they harbor and because of their vulnerability to nutritional deficiencies (Luka *et al*., 2000). According to (Crompton, 1985), the intestinal nematode *Ascaris lumbricoides* alone, infects approximately 25% of the world's population annually, although the infections are often asymptomatic, their effects are enormous and may contribute substantially to child morbidity especially when associated with malnutrition, anaemia, enteric diseases and vitamin A deficiency.

In view of the negative socio-economic impact of these parasitic infections on children, there is the need for the development of good preventive and control measures to ensure proper eradication. This cannot be done effectively without baseline data on the occurrence of parasitic infections in the areas mostly affected. The occurrence of intestinal parasitic infections among pre-school children in Nigeria is largely unreported (Kirwan *et al*., 2009). Accordingly, published data on the status of helminthiasis among pre-school children in Katsina area is very scanty. Hence, this research was designed to assess the prevalence and risk factors for helminthiasis among pre-school children in the study area. Data from this research provides an insight on the situation on ground for proper diagnosis, planning and implementation of control programmes in the area.

MATERIALS AND METHODS

Study Area

The study was carried out in Katsina urban area, Katsina state, Nigeria. Katsina town is the administrative headquarter of Katsina state, Nigeria. The town lies approximately on Latitude 12^{o}59' North of the Equator and Longitude 7^{o}36' East of Greenwich Meridian at an altitude of about 519 metres above sea level. The 2018 estimates put the town's population at 432,149 people (World population reviews, 2018).

Study Population and its Selection

The study was carried out in Katsina metropolis of Katsina state Nigeria. The sample population for this study was selected using the random sampling method and the residence areas were selected based on stratification pattern (Jelliffe, 1966). The inner core area, the working class area and the peripheral area mostly for top civil servants in the area were stratified for the purpose of sample selection.

The children were therefore categorized according to the areas. A random sampling technique was used to select the children in each category. The number of children studied in each group was calculated by probability proportional to the size of the actual number of children in each locality. Selection of the children was then made by systematic sampling with a random chart, having calculated the sampling interval for each neighborhood. Accordingly, out of the 330 children enrolled for the study, 302 children were able to participate fully at all stages of the research and thus constitute the number used in the final analysis.

Ethical Consideration

Before embarking on the study, permission was obtained from the Departmental research committee after careful scrutiny of the research proposal. Similarly, meetings were held with the parents of the children to request for their consent before being enrolled as participants in the research. At each point, the parents were informed that participation in the research is voluntary; hence they may decide to withdraw themselves and their children at any point without necessarily giving prior notice. They were also informed that all information gathered will be kept confidential and used exclusively for research purposes. Furthermore, all procedures followed in the conduct of this research were in accordance with the ethical standards approved by the University's Board of Research and the State Ministry of Health. It is also in accordance with the Helsinki Declaration (1975) on the use of human subjects in research.

Data Collection and Faecal Examination

Socioeconomic data of the selected children and their parents were entered into a pretested questionnaire. The questionnaires sought for information including, source of water, cleanliness, toilet facilities, geophagy, playing barefooted, education of the parents etc. Early morning

stool of each selected child was collected in clean stool sample bottles with wide mouth and screw caps. Each bottle was clearly labeled with the respective child's serial number for easy identification. Demonstration was done by the researcher on how to collect the stool sample to avoid possible contamination during collection. All the stool samples collected were preserved with 5% formalin and transported immediately to the laboratory in the Department of Biology of Umaru Musa Yar'adua University Katsina, for further analysis.

Formol-ether concentration technique as recommended by WHO, (1991), was used for the stool analysis. Approximately one gram of faeces was suspended in 10ml of 10% formaldehyde solution and mixed with a glass rod. The suspension was passed through a funnel covered with a gauze pad into a centrifuge tube. Then 3 ml of ether was added and the suspension was mixed for 1 minute. The tubes were centrifuged for 1 minute at 4000 rpm. Thereafter, the tubes were removed from the centrifuge machine and the supernatant discarded leaving the sediment. The sediment was examined by sampling a drop with a Pasteur pipette and depositing it on a glass slide and mounted on a microscope. The stool sample is examined using x10 and x40 objectives with condenser iris placed very close so as to give good contrast (Cheesbrough, 2006).

Statistical Analysis

All the data obtained was entered into an SPSS (Statistical Package for Social Sciences) file and processed using the SPSS software version 20.0 for windows. The data was thoroughly cleaned to ensure that all possible errors during entry were avoided before analysis. Prevalence was determined according to (Margolis, Esch, Holmes, Kuris, & Schad, 1982). Chi-square statistics was used to assess the possible risk factors associated with the infection. Descriptive statistics were used to calculate the frequencies and percentages of the different variables assessed.

RESULTS AND DISCUSSION

The study on the prevalence of intestinal helminth infections among Pre-school children in Katsina metropolis was conducted between the months of March to August, 2016. A total of three hundred and two (302) children aged 1 – 5 years, fully took part in the research. The children were categorized by age group was into two groups viz; 1 - 3years and 4 - 5years. The age group 1 - 3 years comprises of 140 children or 46.4% of the study subjects, while those 4 - 5 years were 162 (53.6%). Gender wise grouping showed that there were 144 (47.7%) males and 158 (52.3%) females. Socio-economic profile of the parents showed that 170 (56.3%) of the fathers/guardians of the children had at least 6-years formal education while 132 (43.7%) had no formal education. Moreover, majority (66.2%) of the mothers of the children had at least 6-years formal education, while the rest (37.8%) of the mothers had no formal education. Regarding the possession of toilet facilities, our findings showed that almost all the houses posses' toilets. Categorisation of the toilets types into pit, flush and others, indicated that about half (50.3%) of the subjects had pit toilets in their houses, 21.2% had flush toilets while 28.5% used other means for defaecation. Hand washing habit before and after eating were also assessed and found that all the studied subjects had their hands always washed before and after eating. The general socio-demographic characteristics of the study population and their parents are shown on (Table 1).

Our survey of STH infections among the study population showed that One hundred and eighty-two (182) out of the 302 pre-school children that participated in this survey or 60.3% of the children were positive for at least one STH species. The result indicated that the trio of *Ascaris lumbricoides, Trichuris trichiura* and the Hookworms were all prevalent among the children. *A. lumbricoides* (79.1%) was the most prevalent parasite afflicting the children; it was followed by Hookworm with 20.9% while *T. trichiura* was the least prevalent with 5.5%. Moreover, most of the infections occur as single status infections accounting for 94.6% while mixed infections accounted for only 5.4% of all the infections among the study children, as shown on (Table 2).

The findings from this study showed that, the females had the higher prevalence of infections in general with more than 70% of them being infected as compared to the males with a total prevalence of 52.8%. Moreover, in terms of age groups, our findings revealed that the children aged 4 - 5 years had a higher prevalence rate with 82.7% of them infected by the helminths, as compared to those aged 1 – 3 years who had a prevalence of 41.4%. The general prevalence of infection by gender and age among the study population is shown on (Table 3).

Based on the findings from this study, several factors could be responsible for the high rate of infection among the study population involved in this survey. For instance, the result of the survey as analysed using the Chi-square statistics indicated that age 4-5 years (OR, 0.19; CI, 0.09-0.39; χ^2 = 22.379; P = <0.001), female gender (OR, 0.44; CI, 0.22-0.85; χ^2 = 6.056; P = 0.014), drinking of untreated water (OR, 0.03; CI, 0.01-0.08; χ^2 = 63.824; P = <0.001) and Geophagia or soil eating (OR, 2.67; CI, 1.35-5.26; χ^2 = 8.217; P = 0.004) were the major risk factors associated with the infections among the children that participated in this research. However, Mother's education status (χ^2 = 2.772; P = 0.096), Father's education status (χ^2 = 0.169; P = 0.681) and Playing bare footed (χ^2 = 2.776; P = 0.096) did not show any significant association with infection among the children. The details of the possible risk factors associated with STH infections among the subjects are shown on (Table 4).

Table 1. Some socio-demographic characteristics of the study population (N = 302).

Characteristic	Number	%
Gender		
Males	144	47.7
Females	158	52.3
Age group		
1 – 3 years	140	46.4
4 - 5 years	162	53.6
Father's education level		
At least 6 years formal education	170	56.3
No formal education	132	43.7
Mother's education level		
At least 6 years formal education	200	66.2
No formal education	102	33.8
Presence of toilet in the household		
Yes	302	100
No	0	0
Type of toilet facility		
Pit	152	50.3
Flush	64	21.2
Others	86	28.5
Hand washing before/after eating		
Yes	302	100
No	0	0
Domestic water source		
Treated	144	47.7
Untreated	158	52.3
Soil eating/Geophagy		
Yes	144	47.7
No	158	52.3
Playing Barefooted		
Yes	156	51.7
No	146	48.3

Table 2. Identity and distribution of parasite species detected and type of infection.

Variable	Frequency (%)
Identity of Parasite species	
Ascaris lumbricoides	79.1
Trichuris trichiura	5.5
Hookworm	20.9
Type of infection	
Single	94.6
Mixed	5.4
Total prevalence	60.3

Table 3. Prevalence of infection by gender and age group.

Variable	No. infected (%) with individual parasites			Total (%)
Gender	*Ascaris*	*Trichuris*	ookworm	
Male (n=144)	56 (73.7)	4 (5.3)	16 (21.0)	76 (52.8)
Female (n=158)	88 (75.9)	6 (5.2)	22 (18.9)	116 (73.4)
Age group				
1-3 years (n=140)	40 (69.0)	2 (3.4)	16 (27.6)	58 (41.4)
4-5 years (n=162)	104 (77.6)	8 (6.0)	22 (16.4)	134 (82.7)

Table 4. Risk factors for STH infection among the study population (N=302).

	STH infection status		
Variable	No. infected (%)	OR (95% C.I.)	P-value
Gender			
Female	116 (73.4)	0.44 (0.22, 0.85)	0.014*
Male	76 (52.8)	1	
Age group			
1-3 years	58 (41.4)	0.19 (0.09,0.39)	<0.001*
4-5 years	134 (82.7)	1	
Father's education status			
≥6 years formal education	105 (61.8)	0.87 (0.45, 1.68)	0.681
No formal education	87 (65.9)	1	
Mother's education status			
≥6 years formal education	137 (68.5)	1.77 (0.90, 3.55)	0.096
No formal education	55 (53.9)	1	
Drinking water source			
Untreated	143 (90.5)	0.03 (0.01, 0.09)	<0.001*
Treated	49 (35.0)	1	
Geophagy (Soil eating)			
Yes	109 (75.7)	2.67 (1.35, 5.26)	0.004*
No	83 (52.5)	1	
Playing bare footed			
No	103 (66.0)	0.57 (0.30, 1.11)	0.096
Yes	89 (61.0)	1	

*Significant risk factor; OR= Odds ratio; C.I. = Confidence interval.

The present survey attempts to examine the prevalence of soil transmitted helminths infections among pre-school children in Katsina metropolis. A total of three hundred and two (302) children fully participated in the survey after the consents of their parents were duly sought. Majority (52.3%) of the children that participated in the survey were females while the rest were males. Similarly, 53.6% of all the children that participated in the study were aged 4 - 5 years old, while the remaining were 1-3 years old. Moreover, the education profile of the parents showed that more than half of the parents (fathers and mothers) of the children were all educated having obtained at least 6 years' formal education. A survey of the sanitary profile of the households where the children belong indicated that all the houses had toilet facilities and all the parents indicated they washed the hands of their children before and after eating food or after going to the toilets.

The result of the parasitological survey of the children indicated that about two-thirds of all the children that participated in the survey were infected by at least one important Soil transmitted helminth namely; *Ascaris lumbricoides, Trichuris trichiura* or Hookworms. This result is similar with the findings from many previous researches from different parts of the country (Nmorsi *et al*., 2009; Salawu & Ughele, 2015; Sowemimo & Asaolu, 2011). The consistency of our findings with previous findings could be associated with the general low level of hygiene, low level of epidemiological awareness among the people as well as the favourable environmental condition for the survival and development of the parasites that prevails all over the country. *Ascaris lumbricoides* was the most prevalent helminth parasite encountered. It accounts for about 80 percent of all the infections among the study children. Our findings concur with the findings from other similar studies in Nigeria (Ahmed *et al*., 2003; Nmorsi *et al*., 2009; Salawu & Ughele, 2015; Udonsi *et al*., 1996). *Ascaris lumbricoides* is often said to be the most widespread of all the soil transmitted helminth parasites especially in Africa, China and some Latin American countries (Chan, 1997; O'lorcain & Holland, 2000; Shang *et al*., 2010). *Ascaris* spreads more easily through contaminated foods, water or soil organic matter. The eggs remain viable under favourable conditions for more than one year (Chan, 1997).

The prevalence of the infections were highest in the age group 4-5 years old as compared to that of the younger children aged < 4 years, this showed that age had strong effects on both infection dynamics and epidemiological statistics and expressed the importance of this group as environment contaminators within the community. Our findings concur with the findings from previous similar researches (Chan *et al*.,1994; Mwambete & Kalison, 2006). Children aged 4-5 years are likely to be more infected due to the fact that at this age bracket, children tend to be more separated with their mothers coupled with the fact that their immunity to parasitic infections is not well developed and that they play so much with soil. Similarly, at this stage in life many children from the habit of soil eating which could further expose them to infection as postulated earlier by Stephenson *et al*. (2000). Children above 3 years are wiser enough to play outside their homes with friends and elders. Some of them have also commenced attending kindergarten

classes where they could play around on school play grounds and class environs. This exposes them to possible risk of infection by helminth parasites.

Children are perhaps particularly at risk of ingestion of viable parasite eggs while playing on contaminated grounds. Moreover, larvae of Hookworms can easily penetrate the skin of children when in contact during play or when walking barefooted in contaminated environments. Children that are particularly in the habit of eating soil (geoghagy) are at greater risk of infection by these parasites. *Trichuris trichiura* is the least prevalent parasite among the children that participated in the survey. This agrees with findings from previous similar studies (Adeyeba & Dipeolu, 1984; Wagbatsoma & Aisien, 2005). The least occurrence of *Trichuris* among the subjects may relate to the environmental conditions which could be unfavourable for the survival of the *Trichuris* eggs in the soil. The soil in Katsina area is mainly the sandy loam which becomes extremely hot during the day which could affect the viability of the *Trichuris* eggs.

A close look at sex distribution and prevalence of infection among the participating children indicated that the female subjects were significantly more infected than their male counterparts. This finding is similar to that from earlier studies conducted in Tanzania (Mwambete & Kalison, 2006) where female under-fives tend to be more infected compared to their male counterparts. The general high prevalence among the various gender groups that participated in this study could be attributed among other several causes, the poor knowledge of intestinal helminthiasis by the mothers. We observed that in the study area, both the children were given similar care by the parents and hence had similar rate of exposure to the possible risk factors, hence the difference in infection could be purely by chance. An investigation into the other possible risk factors of infection among the children that participated in this survey revealed that, drinking of untreated water was also associated with soil transmitted helminths infections among them. The use of untreated water has been long recognized as a great risk to intestinal parasitic infections. Reports from previous studies in Ethiopia (Belyhun *et al*., 2010) and Malaysia (Abdulhamid Ahmed *et al*., 2011), have shown a significant association between drinking water from untreated sources and helminthic infection. Untreated water is likely to be contaminated with pathogens and germs which could be hazardous when consumed ignorantly. However, all these factors could be directly or indirectly linked with low socioeconomic status and could be attributed to several other factors including, poor personal hygiene, contaminated environment, illiteracy and living in overcrowded conditions (Houweling *et al*., 2003). In this survey, children that developed the habit of geophagia (soil eating) were found to be significantly more infected than those that do not eat soils. This is in agreement with the findings from a previous study in Calabar, Cross river state (Etim & Akpan, 1999). Eggs and larvae of helminth parasites could remain viable in the soil for a long period of time and if by any chance they happen to be ingested, they could cause infection. Hence, contaminated soils are common sources of infection by helminth parasites.

CONCLUSION

This survey was conducted in an urban settlement whereby the people are more educated and more enlightened. However, intestinal helminthiasis was found to be highly prevalent and a matter of public health concern among the children in the study area. The high prevalence of intestinal helminth infection in the area was associated with Age, Gender, Habit of soil eating and consumption of untreated water among the study population.

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