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Status And Risk Factors Associated With Infantile Geohelminths Infections In Sokoto State, Nigeria.

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Abstract: *A study on geohelminths infections among infants in Sokoto State was conducted in nine Local Government Areas between the months of August, 2013 to December, 2014 in order to evaluate the status of infantile geohelminthiasis and the associated risk factors in Sokoto State. Stool samples obtained from 1620 infants aged 1 to 24 months were screened using the formol- ether concentration techniques. An overall low prevalence of 1.4% was obtained in the State. Hookworm has the highest prevalence of 17(1.0%), followed by S. stercoralis with an overall prevalence of 4(0.2%). A. lumbricoides with 2(0.1%) and T. trichiura with1 (0.1%). There was significant difference between the rates of infection in the studied Local Government (χ^2 = 24.361, df = 8, P = 0.002), an indication that the infection rate in all the Local Governments in the State is not the same. Risk factor for the infection in the State is associated to water source (P < 0.05) and infant that has well as their source of drinking water has higher risk of been infected than those that has tap as source of drinking water. There is therefore the need for provision of portable drinking water in the State.*
Keywords: *Geohelminth, Risk factor, Infantile, Sokoto State.*

I. Introduction

Soil transmitted helminths (STHs) or geohelminths are a group of intestinal parasites that belong to the Class Nematoda, eggs require a period of maturation (2-4 weeks) in the soil to become infective (WHO, 2014). These worms do not multiply in the human host, reinfection occurs only as a result of contact with infective eggs/larvae in the environment.

Children aged 24 months and less make up between 5 and 10% of the 3.5 billion people either infected with or at risk of infection from STHs (Murray et al., 2013). Evidence suggests that STHs have a potential effect on growth and development of children less than 24 months of age (Chirdan et al., 2010; Alemu et al., 2012).

Despite this, children of this age group continue to receive little or no attention, largely because of lack of specific studies on such children giving rise to paucity of epidemiological data. Hundreds of cases of infantile disease associated with bloody stools, melena, anorexia, listlessness and oedema were reported in China in the 1960s. Hookworm eggs were later detected in the faeces of the reported cases. With the exception of a single worm identified as Necator americanus, all the rest adult worms expelled following chemotherapy or examined at autopsy were Ancylostoma duodenale. Many children showed clinical manifestations and eggs in their faeces on day 1–26 after birth, and more cases occurred within 3 months of birth. Evidently, these infections were mostly transmitted from the mothers by transplacental and/or transmammary routes (Sen-Hai et al., 2000). An epidemiological survey on geohelminths infection indicates that infantile geohelminthiasis can occur at a high prevalence of 43.8% in Zanzibari (David et al., 2007) and 50.3% (Awasthi et al., 2008) in India. Yeshambel et al. (2010) reported a low prevalence of 4.9% among infant in Ethiopia. Until recently, Kirwan et al. (2009) reported 13.01% infection rate on infantile geohelminthiasis in Ogun State, Nigeria, there seems to be a bias in epidemiological surveys of intestinal helminths in favour of school-age children due perhaps to the general believes that infants are more restricted and are not generally exposed to contract infection. There is also difficulty in sample collection, lack of cooperation and general acceptance. Put together, these create low tempo in research and reporting; this situation prevails in Nigeria such that research in this very important area of helminthiasis has been neglected creating a knowledge gap needed to define the status of the disease and to plan and execute intervention programmes. The present study aimed at bridging the gap in knowledge of infantile geohelminthiasis in Sokoto State.

II. Materials And Methods

Study area

The study was conducted in Sokoto State. Sokoto State is estimated to have a total population of 3,696,999 (1,872,069 male and 1,824,930 female) (NBS, 2006). Sokoto State is in the semi arid zone, surrounded by sandy soil and isolated hills. The state is located in the North-West geographical zone of Nigeria within latitudes 4°00ˈ - 6°40ˈN and longitudes 11°30ˈ-13°50ˈE (Musa and Ala, 2011). Sokoto State maximum day time temperatures are generally under 40^{o}C (104.0^{o}F) and the dryness makes the heat bearable. The warmest months are between February to May when daytime temperatures could exceed 45^{o}C (113^{o}F). The rainy season is from June to October and dry season, from November to May.

Study population

The study population consist of randomly selected infants who are between 1-24 months old (McGraw, 2002), residing in households of Sokoto State.

Ethical Considerations: As the participants, infants to be included were 1- 24 months of age; therefore the informed consent was sought from the parents. The ethical approval of the study was sought and obtained from the State Ministry of Health and State ethical Review Committee and the Ministry for Local Government.

Faecal sample collection

An advocacy meeting was held in each study village. The purpose of the study was explained to as many inhabitants as possible. Local Government Health officers helped mobilize mothers and participation in the study was voluntary.

Data on the independent variables, socio-demographic characteristics of mother and child behavioral characteristics was collected through administration of a structured questionnaire that was administered on the mothers /caregivers of the infants.

At the time of interview, the mothers / caregivers was given a dry, clean, leak proof 20ml sample bottle labeled with the identification number for the collection of stool sample of the child, which was collected back from the mother / caregivers of the child the following day. The mothers / caregivers of the child were guided on how to collect the samples. The specimen was collected, kept in a cool box and transported to the Parasitogical Laboratory of the Veternary Department, Ahmadu Bello University Zaria, Kaduna State for further analysis.

Sample analysis

The stool examination was carried out at the Parasitological Laboratory of the Veternary Department, Ahmadu Bello University Zaria, Kaduna State by the researcher with the assistance of an experienced laboratory Technologist. Direct examination of faeces for parasites or eggs and the formal–ether concentration method was used to process all faecal samples (Cheesbrough, 2005; CDC, 2006). The formal ethyl concentration method is the most frequently used because it concentrates a wide range of parasites with minimum damage to the parasite morphology (Arcari et al., 2000). 10 ml of 10% formalin was poured into a centrifuge tube; 1g of the stool sample was picked with an applicator stick and emulsified; the mixture was filtered using a 425 mm aperture sieve, and the filtrate poured into a new centrifuge tube until 7ml mark was reached; 3ml of ether was added to the mixture and the mixture was centrifuged at 4000 rpm for 1minute.The resultant mixture appeared with ether as the topmost layer, followed by the faecal debris and the formalin solution while the parasitic sediment remained at the bottom. The topmost 3 layers was discarded while 2 drops of the sediment was dropped on each side of a clean grease free glass slides, emulsified with normal saline on one side and iodine on the other side; the preparations was then covered with a cover slip and examined first using x10 objective and confirmed with x40 objective of the microscope (Allen & Ridley, 1970).

Parasite eggs were identified using the chart of Cheesbrough (2005).

Data analysis

Data analysis was done using the Statistical Package for Social Sciences (SPSS) software version 20.0 (SPSS Inc Chicago, IL, USA). Descriptive statistics was used in analyzing all data. Prevalence was calculated and expressed as percentages and the chi-square test was used to determine association between prevalence and sex of infants; used to compare data between agesS and to determine the significance differences between percentages; used to determine association of the risk factors and prevalence of helminthiasis.

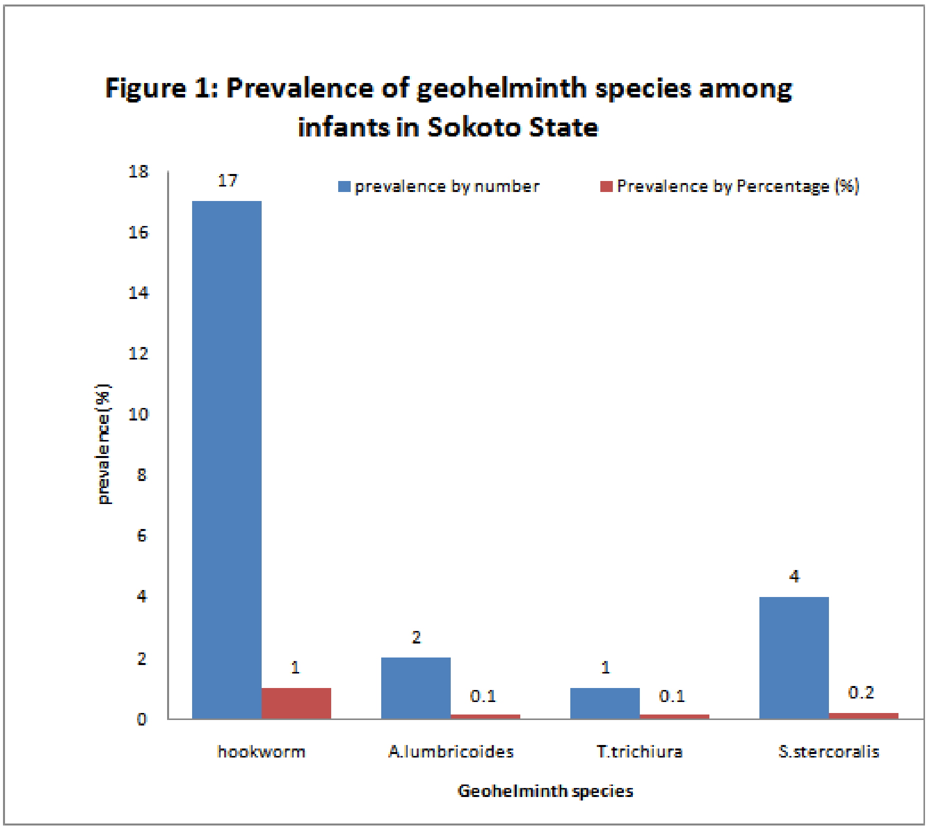
III. Results

Table 1 shows the characteristics of the studied population. Out of the1620 infants examined for the research, 837(51.7%) were male while 783(48.3%) were female. The age categories of the infants are 1-6(months); 7-12; 13-18 and19-20 months with corresponding number as 157(9.7%); 332(20.5%); 520(32.1%) and 611(37.7%) respectively. 67(4.1%) of the mothers had formal education while 1553(95.9%) had informal education. 993(61.3%) of the mothers are full house wife while 627(38.7%) are traders. 1173(72.4%) have tap as their source of drinking water while 447(27.6%) drank from the well. 1619(99.9%) of the population had pit latrine in their home while only 1(0.1%) defecate in the bush.1606(99.1%) of the mothers had knowledge of helminthiasis while 14(0.9%) had no knowledge of the disease.

Table 1: Characteristics of the study population

Characteristics	Category	Total number	%
Age (months)	1-6	157	9.7
	7-12	332	20.5
	13-18	520	32.1
	19-24	611	37.7
Sex	Male	837	51.7
	Female	783	48.3
łucation	Formal	67	4.1
	Informal	1553	95.9
Occupation	House wife	993	61.3
	Trader	627	38.7
Water source	Tap	1173	72.4
	Well	447	27.6
Toilet facility	Pit latrine	1619	99.9
	Bush	1	0.1
Knowledge about Helminthiasis	Yes	1606	99.1
	No	14	0.9

Overall prevalence of infantile geohelminthiasis is shown in figure1. Hookworm has the highest prevalence of 17(1.0%), followed by S. stercoralis with an overall prevalence of 4(0.2%). A. lumbricoides with 2(0.1%) and T. trichiura with1 (0.1%).



Out of the 837 male examined 1(0.1%) is positive, each for A. lumbricoides and T.trichuira. 2(0.2%) is positive for S. stercoralis and 8(1.0%) is positive for Hookworm. The female had 0% prevalence for T.trichiura; 1(0.1%) prevalence for A.lumbricoides; 2(0.3%) prevalence for S.stercoralis and 9(1.1%) prevalence for Hookworm. P-value for the infections with respect to sex is not significant at 0.05%.

Table 2: Prevalence of geohelminth infection with respect to sex of infants.

Sex	A. lumbricoides (%)	Hookworm (%)	T. trichiura (%)	S. stercoralis (%)
Male(n=837)	1(0.1)	8(1.0)	1(0.1)	2(0.2)
Female(n=783)	1(0.1)	9(1.1)	0	2(0.3)
Total (n=1620)	2(0.1)	17(1.0)	1(0.1)	4(0.2)
P- value	0.962	0.702	0.333	0.947

The prevalence of infantile geohelminths infection with respect to age is shown in Table 3. Ages 1-6 months (n= 157) had 0% prevalence for A.lumbricoides; 2(1.3%) prevalence for hookworm; 1(0.6%) prevalence for T. trichuira and 3(1.9%) prevalence of S.stercoralis. Ages 7-12 months (n=332) had 1(0.3%) prevalence for A. lumbricoides; 2(0.6%) prevalence for Hookworm; 0% prevalence for T.trichiura and 1(0.3%) prevalence for S.stercoralis. Ages 13-18 months (n=520) had 1(0.2%) prevalence for A.lumbricoides; 4(0.8%) for Hookworm and 0% prevalence each for T.trichiura and S.stercoralis. Ages 19-24 months (n=611) had 0% prevalence each for A.lumbricoides, T.trichiura and S.stercoralis. A prevalence of 9(1.5%) is recorded for Hookworm. P-value for S.stercoralis and T.trichiura infections are significant at 0.05%.

Table 3: Prevalence of geohelminth infection with respect to age of infants

Age (months)	A. lumbricoides (%)	Hookworm (%)	T. trichiura (%)	S. stercoralis (%)
1-6 (n=157)	0	2(1.3)	1(0.6)	3(1.9)
7-12 (n=332)	1 (0.3)	2(0.6)	0	1(0.3)
13-18 (n=520)	1 (0.2)	4(0.8)	0	0
19-24 (n=611)	0	9(1.5)	0	0
Total (n=1620)	2 (0.1)	17(1.0)	1(0.1)	4(0.2)
P- value	0.572	0.539	0.025	0.001

The prevalence of infantile geohelminths infection in relation to environmental factors is indicated in Table 4. Prevalence in relation to water source shows that tap (n=1173) had 11(0.9%) prevalence and well (n=447) had prevalence of 13(2.9%) prevalence. The prevalence in relation to toilet facility shows that mothers that use pit latrine (n=1619) had 24(1.5%) prevalence and bush (n=1) had 0% prevalence. P-value for geohelminths infection in relation to water source is significant ($P < 0.05$).

Table 4: Prevalence of geohelminth infection in relation to environmental factors.

Environmental factor	Category	No examined	No positive	%	P- Value
Water source	Tap	1173	11	0.9	**0.003**
	Well	447	13	2.9	
Toilet facility	Pit latrine	1619	24	1.5	0.902
	Bush	1	0	0	

Table 5 shows the risk factors of infantile geohelminths infection in the study area. Infection in relation to water source is significant at 0.05%.

Table 5: Risk factors of geohelminth infections among infants in Sokoto State.

Factor	Prevalence		Total (%)	X^2	P-value
	Yes (%)	No (%)			
Sex					
Male	13(1.6)	824(98.4)	837(51.7)	0.061	0.805
Female	11(1.4)	772(98.6)	783(48.3)		
Age					
1-12	10(2.0)	479(98.0)	489(30.2)	6.572	0.087
13-24	14(1.2)	1117(98.8)	1131(69.8)		
Water source					
Tap	11(0.9)	1162(99.1)	1173(72.4)	8.611	**0.003**
Well	13(2.9)	434(97.1)	447(27.6)		
Toilet facility					
Pit latrine	24(1.5)	1595(98.5)	1619(99.9)	0.015	0.902
Bush	0	1(100)	1(0.1)		
Hand washing					
Yes	24(1.6)	1509(98.4)	1533(94.6)	1.383	0.240
No	0	87(100)	87(5.4)		
Education					
Formal	2(2.9)	65(97.0)	67(4.1)	1.083	0.298
Informal	22(1.4)	1531(98.5)	1553(95.9)		
Occupation					
Trader	12(1.9)	615(98.10)	627(38.7)	1.310	0.252
House wife	12(1.2)	981(98.8)	993(61.3)		

IV. Discussion

The study found a low prevalence of 1.4% geohelminths infection among infants. Low prevalences of Hookworm (1.0%); S. stercoralis (0.2%); A lumbricoides (0.1%) and T. trichiura (0.1%) have also been reported by Adamu et al. 2006 who studied helminths infections among School Children in Wamakko Local Government Area of Sokoto State: where Ascaris lumbricoides; Trichuris trichiura; Strongyloides stercoralis and Hookworm recorded 17.5%; 2.0%; 1.0% and 0% respectively. A similar prevalence of 1.0% has also been documented among day care children in Brazil (Nilson et al., 2001). The 1.0% overall prevalence value of hookworm was relatively low when compared with previous reports obtained elsewhere both within and outside the country (Imandel et al. 2004) in Plateau State, Kawo et al. (2004) in Kano State, Luka et al. (2000, 2006) in Kaduna State, Onwuliri et al. (1992) in Plateau State and David et al. (2007) in Zanzibar, Tanzania). The relatively low prevalence value could be attributed to the inability of the 3rd stage infective larvae to access human skin as penetration of skin is a major route of infection (Bundy and de Silver, 1998). Another explanation for the relative low prevalence could be attributed to the survival rate of the larvae in the soil as texture and type of soil markedly influence the viability of the 3rd stage infective larvae (Hotez, 2006). The viability of the larvae is optimal on sandy, warm, humid soil (Brooker, et al., 2004). A low prevalence of hookworm (3.5%) was also documented by Mordi et al. (2012), in Edo State.

A comparatively low prevalence value of 0.2% was recorded for Strongyloides stercoralis in Sokoto State. Low prevalence's have also been reported within and outside the state; 3% prevalence value of S. stercoralis was recorded in Ile-Ife (Holland et al., 1989), 1.67% prevalence value was recorded in Zaria (Abdullahi and Adbulazeez, 2000), 0.5% prevalence was recorded in Brazil (Nilson, et al., 2001), 1.4% prevalence value was recorded in Awka, Anambra State (Eneanya and Anikwue, 2005) and Adamu et al. (2006) reported 1.0% S. stercoralis among school children in Wamakko Local Government area of Sokoto State.

A low prevalences of 0.1% was recorded each for Ascaris lumbricoides and T. trichiura. The low prevalence recorded for Trichuris trichuira was in line with the report of Nilson et al. (2001), in Brazil, where 0% prevalence was recorded among day care children. Low prevalences of T. trichuira although higher than what was obtained in this survey was also reported by some authors: T. trichiura of 1% was observed in Cross-River (Okon and Oku, 2001), a 3% prevalence of T. trichuira was recorded in Etulo, Benue State, Nigeria (Atu et al., 2006). Other studies on children aged less than 24 months demonstrated that the prevalence of A. lumbricoides ranged from 6.2% in Nicaragua (Oberhelman et al., 1998) to 66% in Zaire (Mbendi et al., 1988). The low prevalence of A. lumbricoides (0.1%) in children aged less than 2 year compares well with studies undertaken in Rio de Janeiro (4.3%) (Concha et al., 2005), and Nigeria (7.6%) (Asaolu et al., 2002) and (2.9%) (Kirwan et al., 2009).

There was no difference in the prevalence rate of each parasite with respect to sex as the infants at this stage are at their young ages and there is similarity in exposure risks to the infective agents in the environments.

Infection with each parasites decrease with increase in age of infants except for Hookworm species that increase with age as found in other studies (Bradley and Chandiwana, 1990; Bundy et al., 1992). Prevalence of T. trichuira and S. stercoralis infection with respect to age of infants is significant ($P < 0.05$). Strongyloides stercoralis is generally omitted in clinical practices and a control programme because of its relatively less significant influence on health and socio- economic conditions and also, it is not restricted to humans, as it is common in pets (Buonfrate et al., 2013, Marcos et al., 2013). However, there have been cases of mother to baby transmission of S. stercoralis (Grove, 1993). This survey did not obtain any information on pet ownership; therefore, the reason for the highest prevalence of S. stercoralis among young infants could not be ascertained.

The study reveals the risk factor to infantile geohelminths infection in the study area to be associated to water source, as infection in relation to water source is significant ($P < 0.05$). Infants that have well as water source has higher prevalences (2.9%) when compared to those that use tap water (0.9%). The use of wells as sources of drinking water in some of the villages might have exposed the infants to helminths infections. This could be due to contaminants being introduced into the wells via the containers used in drawing the water and or direct dumping of dirt's into the wells. Contamination of well water with disease-causing agents had been documented in parts of Nigeria (Inabo et al., 2000; Gundiri et al., 2000). Adebote et al. (2004) reported that contaminative helminth infections are positively associated with well water. These water sources are not usually covered, hence they are predisposed to contamination by waste including human and animal faeces containing cysts, ova and or larva spread by vectors as flies (WHO, 2014; WHO, 2015). The chances of ingesting parasites cysts or ova in water are thereby greatly enhanced. This study also found that using water from a pipe inside a compound was a risk factor for helminth infection in infants. Other studies have shown that helminth infection among pipe users in developed countries may arise from the poor quality of pipe water (Cameiro et al., 2002).

Efforts to minimize microbial contamination of pipe water supplies and to monitor water qualities are important. However, other unknown factors may contribute to the increased risk associated with water and merit further investigation.

Infantile geohelminths infection is not of public health significance in Sokoto State because the prevalence obtained is low when compared with the WHO standard. This could be as a result of helminth control interventions, which might have reduced the infections in the population.

The objective of regular deworming has been achieved in Sokoto State, because the objective is not to cure since re-infection is envitable, but to reduce and keep the worm burden of infected individuals below the threshold that is associated with morbidity.

Water is an important risk factor for infantile geohelminth infection in Sokoto State. Therefore Government should intensify provision of safe and clean portable drinking water for people in the State.

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