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The Epidemiology of Hookworm Infection among Primary School Pupils in Dantube, Dawakin-Kudu Local Government Area, Kano State, Nigeria

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Abstract
Study on the epidemiology of hookworm infection (Ancyclostomiasis and Necatoriasis) was conducted among primary school pupils in Dantube, Dawakin kudu local government Area of Kano State, between August,2015 to January, 2016. Of the 400 samples collected and examined 290 (72.5%) were positive for single or multiple infections. The prevalence of the infection was significantly higher among males (69.31%, p-value 0.102) than females (30.68%, p-value 0.147) ($p < 0.05$). Children in the age group 10 – 12 years had highest prevalence (92.68%) of hookworm infection and those between the ages of 13 – 15 years had (26.56%) the least infection. Those children who defecate in bush were more likely to be infected than those who use modern toilet facility (R = 0.6). Analysis of the responses from the questionnaire shows that parents occupation, civil servant (odd ratio = 4.381) and business (odd ratio = 3.147) shows a strong relationship between prevalence of the disease and risk factor in the research area. Walking with bare foot (odd ratio = 2.142) especially in areas where the soil is dump and moist throughout the year exposed the subject to infection. Hand washing activities (odd ratio = 3.71) have statistical significant effect on the prevalence of the infection. Personal hygiene, public health enlightenment programme should be encouraged particularly among school age children in the research area.
Keywords– Hookworm, infection, *Necator americanus*, *Ancylostoma duodenale*

INTRODUCTION

Hookworm (*Ancylostoma duodenale and Necator americanus)*

The symptoms of hookworm disease ordinarily begin with round itch, an itchy skin and irritation caused by the larvae when they penetrate the skin and marked by papules and vesicles that are often located between the toes (Brooker *et al.*, 2009). In passing through the lungs, the larvae may produce coughing and fever. In the intestine, the mature worm sustains its life by blood sucking, and persistent feeding by man (Copper *et al.*, 2009). The general symptoms include pallor of the skin and mucous membranes, abdominal tenderness, increased appetite for bulky or strange substances (e.g., clay), delayed puberty and stunted growth, fatigue, dullness, and apathy Hookworm infestation tends to be constantly widespread in tropical and subtropical regions of the world; moisture, warmth, loose soil, promiscuous defecation, and absence of shoes are the chief factor responsible for infection (WHO, 2012). Periodic mass treatment of the population has been used in some hookworm control programs. The prevention of hookworm disease consists of ensuring the sanitary disposal of human excreta (Hotez *et al.*, 2004). Estimates of the number of people in the world infected with blood-sucking hookworms ranges from 800 million to 1.25 billion people (WHO, 2012), with at least 1.6 million suffering from significant anemia and 65,000 deaths annually. Forty-four million pregnant women are infected with hookworms, increasing their risk of iron deficiency anemia and related adverse effects on fetal growth, prematurity, and below normal birth weight (Dreyfuss *et al.*, 2000).

Intestinal parasitism caused by hookworm is a major public health problem in the study area (World Bank, 2013). School children carry the heaviest burden of the associated morbidity due to dirty habit of playing or handling of infected soils, eating with soil hands, unhygienic toilet practices and eating of contaminated food or water (Norhayati *et al.*, 1995; Bethany *et al.*, 2002; Hotez *et al.*, 2004). The objective of the study is to elucidate the epidemiology of hookworm infections among school aged children in the study area and relate the infection to sex, age and risk factors among the children.

MATERIALS AND METHODOLOGY

Study area and population

Dantube village is located about 15 kilometers from Kano town along Dawakin kudu by Zaria road, it is a prominent town under Dawakin kudu Local Government Kano state. The inhabitants of Dantube are mainly Hausa. They are mostly Farmers and hence, wet season and irrigation farming are widely practiced. In the year 2006 population Census, Dantube population was 11, 453 inhabitants. The geographical location of Dantube is 11° 50' 4" N 8° 35' 53" E, mean temperature ranges from 22ºC to 29ºC during the rainy season and 30ºC to 37°C during the dry season. Rainfall is bimodal with the short rains between April to June and heavy rainfall between July and September. Mean annual rainfall ranges from 700mm to 1000mm (WSP, 2012). Dawakin kudu district has a population of 416,113 people of which 202,077 (48.6%) are males (NPC, 2006).

Study design and sampling methods

The study was conducted between August, 2015 to January, 2016 during which 400 children were examined with permission from the primary health department of Dawakin-kudu Local Government and Local Education Authority. Fresh morning stool samples were collected in wide mouth plastic bottles containing 10 ml of 10% formaldehyde. The containers were labeled, and immediately transported to the Biology laboratory, Federal College of Education (Technical) Bichi for examinations. Study identification numbers were used instead of children names and information collected was kept confidential. Proportion formula at 95% confidence interval (CI) level (Z = 1.96), 5% marginal error and an expected prevalence of 50% is considered because it is the first research of its kind in the area. Thus, the sample size was calculated using:

$$n = Z^2 P(1-p)/d^2$$

Where: n = sample size

P = Expected prevalence or proportion of problem in the study area

Z = CI of 95%

d = Marginal error to be tolerated

Hence, total of 360 stool samples were to be collected and 90 from each of the selected schools. But due to availability of samples and to minimize error 100 samples were collected from each school (Garcia, 1999; 2001a; 2001b). Hence, total of 400 stool samples were collected.

Selection of schools and children

A random sampling method was used to select the primary schools. The schools selected were namely Dantube Primary School, Tamburawa Special Primary School, Fagi Nomadic Primary School and Tudun Bayero Primary School. In each primary school, all children in primary one and Early Child Center (ECC) classes were randomly selected.

Collection and examination of stool samples

Fecal samples were collected from 400 school-age children between 6 and 15 years old. From each school, at least 100 school children participated in the study. The samples were provided in a plastic container and each plastic container with samples collected from each child was labelled with the child's identification number. Formol-ether concentration as parasitological screening methods was employed. Each specimen was first examined macroscopically and its consistency or nature was recorded in accordance with the description by Estevez and Levine (1985), Smith and Schad (1990) and NCCLS (1997). The procedures were carried out in accordance with standard protocols as described by Katz *et al*., (1972), Garcia (2001a; 2001b) and (WHO, 2011).

Statistical Analysis

Questionnaires were administered to the selected pupils to obtain information from them on the following: Class, age, sex, whether hands are washed after using toilet, whether fruits and vegetables are washed before eating, source of drinking water, water contact activities parent's occupation and possession of pets at home as well as method of waste disposal. The data obtained in the study was presented in tables, interpreted in percentages and analyzed with respect to age, sex, class, sanitation habits, types of toilet system used, source of drinking water, and contact with water bodies. Odds ratio was used to test for association between prevalence and the variables contained in the questionnaire. Chi-square was also used to determine the association between infection and sex as well as age of the children.

RESULTS

Prevalence of Hookworm Infections per School

Prevalence of infection per schools shows that Tamburawa Central Primary School had the least hookworm infection with 56 (19.31%). The highest prevalence of 88 (30.34%) was recorded in Fagi Nomadic Primary School and 77 (26.55%) in Dantube Primary School. However, most of the children examined, 72.50% had a single infection while only 10% had a mixed infection (Table 1).

Table 1: Prevalence of Hookworm Infection according to Schools Selected.

School Name	Number Examined	Number Infected No (%)	Mixed Infection No (%)
Dantube Primary School	100	77 (26.55)	0 (0.0)
Tamburawa Central Primary Sch.	100	56 (19.31)	6 (2.06)
Fagi Nomadic Primary School	100	88 (30.34)	14 (4.83)
Tudun Bayero Primary School	100	69 (23.79)	9 (3.10)
Total	400	290 (76.07)	29 (10.0)
x2		52.436	28.617
p-value		< 0.001	0.002

Prevalence and Sex – Specific of Hookworm Infection

The Sex – specific rate for males (69.31%) was generally higher than for females (30.63%) and However, there was no statistically significant difference in the prevalence of infection between the sexes ($p>0.05$) (Table 2).

Table 2: Sex – Specific Rates of Hookworm Infections among Primary School Children in Dantube, Dawakin-Kudu Local Government Area, Kano State (N=400)

Sex	Number Examined N=400 No. (%)	Number Infected N=290 No. (%)	X^2 No. (%)	p-value No. (%)
Male	284 (71.0)	201 (69.31)	2.913	0.102
Female	116 (29.0)	89 (30.63)	1.634	0.147
Total	400	290 (72.5)	3.730	0.176

Prevalence and Age – Specific of Hookworm Infection

The prevalence of parasite by age showed that the highest prevalence (92.68%) was recorded in children between 10 – 12 years of age and the least prevalence was recorded (26.56%) between 13 – 15 years age group (Table 3).

Table 3: Age – Specific Rates of Hookworm infections among Primary School Children in Dantube, Dawakin-Kudu Local Government Area of Kano State (N=400)

Age group	Number Infected No. (%)
4-6 years (N=142)	109 (76.76)
7-9 years (N=112)	88 (78.57)
10-12 years (N=82)	76 (92.68)
13-15 years (N=64)	17 (26.56)
Total	**290 (72.5)**

Effects of Some Factors on the Prevalence of Hookworm Infections

Responses of the pupils to the questionnaires with reference to some possible risk factors were summarized in Table 4. Statistical analysis to show associations between the factors with infection using odd ratio (OR) of greater than one to indicate weak or strong relationships between the factor and the prevalence of the disease were used. Source of water for house hold use did not have statistically significant effect on the prevalence of the infection when compared with Borehole (odd ratio = 0.21) and well water (odd ratio = 0.3). Water contact activities also indicate that there was no statistically significant association between swimming (odd ratio = 0.045) and fishing (odd ratio = 0.155).

With regards to the use of toilet when compared with stream as reference, the use of pit latrine (odd ratio = 1.521) and bush (odd ratio = 1.493) indicated that there was a statistical significant association between the factor and seem not protective. Analysis of the responses from the questionnaire also shows that parents occupation, notably civil service (odd ratio = 4.381) and business (odd ratio = 3.147) had a strong relationship with the prevalence of the disease. Walking with bare foot (odd ratio = 2.142) especially in areas where the soil is damp and moist throughout the year exposed the subject to infection. Hand washing activities (odd ratio = 3.71) have statistical significant effect on the prevalence of the infection (Table 4).

Table 4: Association of Some Factors with the Prevalence of Hookworm Infections in Dantube, Dawakin Kudu Local Government Area of Kano State (N=400)

Factor	Number Infected	Number Uninfected	Odds Ratio Value	95% C. I.
Source of Water				
Stream [R]	21	11		
Well	204	91	0.3	0.131 - 0.521
Bore-hole	36	105	0.21	0.134 - 0.325
Water contact activities				
i Swimming				
Yes [R]	142	52		
No	24	148	0.045	0.031 - 0.076
ii Fishing				
Yes [R]	86	121		
No	24	219	0.155	0.092 - 0.261
Hand washing				
Yes [R]	134	101		
No	42	67	3.71	2.101 - 6.214
Walk with barefoot				
Always [R]	143	94		
Occasionally	73	56	2.142	0.431 - 7.421
Not at all	8	11	0.671	0.536 - 1.183
Finger nail trimming				
Always [R]	96	124		
Occasionally	142	152	1.672	1.114 - 2.521
Type of Latrine				
Stream [R]	64	73		
Pit	126	72	1.721	0.371 - 0.814
Modern	3	6	0.462	0.261 - 5.831
Bush	143	81	1.793	0.314 - 0.754
Occupation of Parent				
Farmer [R]	210	101		
Civil servant	63	86	4.381	2.245 –4.210
Business	16	32	3.147	2.821 –6.783

[R] = Reference variable

DISCUSSION

The findings of this study show that an overall prevalence of Hookworm was 290 (72.5%) out of 400 samples collected and examined. The adult stages of these worms reside in the intestine, the presence of the eggs in stool is indicative of faecal pollution. This is proved by the fact that Fagi Nomadic primary school which had the highest prevalence (30.34%) of hookworm in the environment does not have toilet facilities. The pupils normally defecate in the nearby bush surrounding the school. This results in the eggs being washed into the school compound when it rains resulting in the environment of the school and surrounding area being highly contaminated with eggs of the parasites. Nigeria like other developing countries is faced with the dilemma of inadequate disposal of excreta-related human waste discharged into the environment.

Thus, the area of this study in rural farming communities of Dawakin kudu local government, it has been a routine practice defecating on open fields and farmlands thereby giving a stable soil contamination with hookworm eggs throughout the year as it concerns open and indiscriminate defecation.

Most of the school children go to school barefooted leading to the high prevalence of hookworm infections. Dantube is still a virgin area whereby no study on hookworm has been done in the area. This further accounted for the high prevalence of the hookworm egg/larvae in the stool samples and environment. Most of the pupils especially those from Fagi Nomadic primary schools and Tudun Bayero Primary School had mixed infection, this results in the environment being heavily contaminated. Highest prevalence rate is similar to what has been reported by Auta *et al*., (2013) and Abdullahi and Abdulhazeez (2000). The high prevalence could be due to unhygienic habit of not washing hands (odd ratio = 1.721) before eating after playing in school and also due to their habit of picking and eating food like biscuits and sweets that had fallen on the ground as they play. This observation is similar to the study by Brooker *et al*., (2009).

The high incidence of hookworm infection (69.31%) in male is from their habit of playing while going to school, hunting and fishing without foot wear. This observation had also been made by Auta *et al*., (2013) that reported higher prevalence of hookworm (62.3%) in males and concluded that, the differences in the prevalence of helminthosis obtained between the males and females might be due to the exposure to water bodies and feeding habits. The prevalence of parasites by age showed that the highest prevalence (92.60%) was recorded in children between 10 – 12 years of age and the least prevalence was recorded (26.56%) between 13 – 15 years age group. Bethany *et al*., (2002) supported this finding and reported a prevalence of 81.6% and 52.4% among children aged 10-12 years and 13-15 years respectively. Hookworm infection was less prevalent among the older age group similar to the reports of Hotez *et al*., (2004) and however, the decrease of the prevalence with age could be attributed to the fact that with increase in age the children are becoming more conscious of personal hygiene as well as development of resistance via increase of immunity. The observation in the prevalence of helminth parasites with age is in conformity with the findings of Nokes and Bundy (1993) who reported that hookworm burden decreased as children moved to higher classes. In a related study by Nwosu (2010) in Delta state a total of 978 pupils were examined for hookworm infections, consisting of 516 (52.76%) males and 462 (47.24%) females. The study indicated that 907 of the 978 children were positive for one or more hookworm infections therefore revealing a general prevalence of 92.74%. Its prevalence though, decreases with age, and pupils within the age 5-7 years had the highest prevalence (90.26%) while those in age group 11-13 years recorded the least (68.97%).

The Sex – specific rate for males (69.31%) was generally higher than for females (30.68%) in this study, however, there was no statistically significant difference in the prevalence of infection between the sexes ($p>0.05$) supported to previous study by Ivoke (2007) involving 420 primary school pupils of both sexes aged 6-14 years, was conducted in 8 primary schools at different locations in Ishielu Local Government Area (L.G.A.) of Ebonyi State, Nigeria, coprological survey to determine the prevalence and intensity of infection of the hookworm parasites. The distributions of the infections were not gender-dependent, and between-sex prevalence was not statistically significant ($p > 005$). The findings from the study thus support the need for the establishment of a health programme for the control of the helminthes in the community.

Statistical analysis to show associations between one factor with another using odd ratio (OR) of greater than one to indicate weak or strong relationships between the factor and the prevalence of the disease were used in responses of the pupils to the questionnaires with reference to every single factor (Table 4). Source of water for house hold use did not have statistically significant effect on the prevalence of the infection when compared to Borehole (odd ratio = 0.21) and well water (odd ratio = 0.3). Water contact activities also indicate that there was no statistical significant association between swimming (odd ratio = 0.045) and fishing (odd ratio = 0.155). With regards to the use of toilet when compared with stream as reference, the use of pit latrine (odd ratio = 1.521) and bush (odd ratio = 1.493) indicated that there was a statistical significant association between the factor and seem not protective. Some cultural practices favour spread of infection.

The use of water for cleaning after defecation, and communal feeding from a common bowl in open street yard, a usual practice in some rural areas, may also account for a high prevalence of hookworm infection (Bundy, 2011).

Meals are often exposed to the wind, insects and domestic animals which may contaminate food with helminth ova while participants in the communal dinner are awaited. Majority of the country is warm and moist for most of the year creating a good environment for the parasites to develop all year round (Abdullahi and Abdulhazeez, 2000). Analysis of the responses from the questionnaire also shows that parents occupation, civil servant (odd ratio = 4.381) and business (odd ratio = 3.147) shows a strong relationship between prevalence of the disease and risk factor in the research area. Low level of education and poor socio-economic status of parents has been associated with helminthic infection in children (WSP, 2012; WHO, 2012). In Nigeria, hookworm infections are still a disease of poverty, as there is a strong correlation between parental socioeconomic status and intestinal parasitosis in children. Auta *et al*. (2013), found a higher prevalence of helminthic infections in children whose parents are unemployed or are petty traders, compared to children of professionals and middle class workers. Walking with bare foot (odd ratio = 2.142) especially in areas where the soil is dump and moist throughout the year exposed the subject to infection. Hand washing activities (odd ratio = 3.71) have statistical significant effect on the prevalence of the infection. In this study itshows that the prevalence of pit latrine (odd ratio = 1.721) and children that did not use toilets but defeacate in bushes (odd ratio = 1.793) is almost the same.

Summary

A total of 400 stool samples were collected and examined for Hookworm infections and 290 (72.5%) were infected. The present investigation has shown that hookworm infection remains a public health problem in the study area. Hookworm infections among the primary school children in the study area are as a result of poor environmental sanitation, low levels of living standards and ignorance of simple health promoting behavior.

Conclusion

Finding from this study reveals that Hookworm infections are common in Dantube, Dawakin kudu local government Kano State, Nigeria. This is a reflection of the poor state of hygiene and high rate of asymptomatic carriers in the community. The result of this study adds to the store of baseline data on the occurrence of hookworm infections among Nigerian Pupils.

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Recommendations

There is need for education and communication strategies that provide information that is specifically targeted at a particular community. This must be done to change the ways that humans behave. Creating awareness for improved sanitation together with chemotherapy and health education could lessen the problem of *ancyclostomiasis* and *necatoriasis*. These measures would improve the quality of life, particularly for children. A change in emphasis to specific community-tailored information would reinforce other programs against hookworm infection.

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