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Prevalence of Hookworm Infection Among Pupils Age 4-15 Years Attending Muchalla Primary School in Mubi North Local Government Area, Adamawa State

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ABSTRACT
Hookworm is a soil transmitted helminth caused by *Necator americanus* and *Ancylostoma duodenale*. A study was carried out to assess the prevalence of Hookworm amongst pupils at Muchalla primary school, Mubi North local Government Area, Adamawa State. Direct smear method for faecal examination was performed and stool specimens were processed following a formal-ether standing operation procedure. The parasites were identified on the basis of morphological characteristics. The data obtained in this study was statistically analysed using descriptive statistics and the result were presented as percentage prevalence. A total of 120 pupils were examined comprising males 65(54.17.0%) and females 55(45.83%). Out of the 120 pupils examined, 26(21.67%) were infected with hookworm. The males are were most infected 17(65.38%) than the female 9(34.62%). The age group 8-11 years shows the highest prevalence of infection 12(46.15%) followed by age group 4-7 years 10(38.46) and age group 12-15 years 4(15.38). It was therefore, concluded that hookworm infection in Muchalla primary school was prevalent. The researcher recommends that, government should encourage the programme of water sanitation and hygiene (WASH) to control and prevent the infection.

Keywords: Prevalence, Hookworm infection, Pupils, Muchalla, Adamawa State

INTRODUCTION

Hookworm is an intestinal parasite of humans. The larvae and adult worms live in the small intestine and can cause intestinal disease. The two main species of hookworm infecting humans are *Ancylostoma duodenale* and *Necator americanus* (CDC, 2013). Hookworm eggs are passed in the faeces of an infected person. If an infected person defecates outside (near bushes, in a garden, or field) or if the faeces from an infected person are used as fertilizer, eggs are deposited on soil. They can then mature and hatch, releasing larvae (immature worms).The larvae mature into a
filariform which is the infective stage that penetrate the skin of humans. Hookworm infection is transmitted primarily by walking barefoot on contaminated soil. *Ancylostoma duodenale* can also be transmitted through the ingestion of larvae. (CDC, 2013).

Human hookworm infection caused by *Necator americanus* and *Ancylostoma duodenale* has been reported worldwide, especially among people in tropical and subtropical countries with low socio-economic status (Hotez, 2014). *Necator americanus* has been found to be more predominant worldwide than *A. duodenale*. In addition, animal hookworms of dogs and cats, *A. ceylanicum* and *A. caninum* have been occasionally reported in humans (Cowper, 2011). High-risk groups suffering from hookworm disease are children and pregnant women. Infected persons who have chronic intestinal blood loss could further develop iron- deficiency anaemia and hypoalbuminemia. Additionally, heavy infection in children causes stunted growth and impairment of intellectual and cognitive development (Cowper, 2011). In the past decade, prevention and control of hookworm infection has been globally neglected because most individuals with light to moderate hookworm infection generally are asymptomatic. In an attempt to control the morbidity, the World Health Organization (WHO) and Japanese International Cooperation Agency launched the project of soil-transmitted control first in Asia in 2004 and scaled-up to East and West Africa in 2005 and 2006, respectively (Cowper, 2011).

The school-based deworming programs could effectively reduce the infection of soil-transmitted helminths in children but could miss positive adult cases. In a few studies, *Ascaris* and *Trichuris* prevalence and intensity go down with age, hookworm prevalence and intensity go up with age.

Ancylostoma braziliense, a canine intestinal pathogen, causes cutaneous larval migrans in humans because the pathogen cannot penetrate the human dermis. Of the two common forms of human hookworm, *N. americanus* is smaller and less aggressive pathogen with a longer life span than *A. duodenale*. Both parasites are found in warm climates throughout the world; *A. duodenale* exists in smaller pockets in Mediterranean countries, Iran, India, Pakistan, and the Far East, where as *N. americanus* is widely distributed throughout impoverished rural areas of the tropics in the Americas, Asia, and Africa (Benthony *et al*., 2013).

Hookworms are small helminths, between 0.5 and 1 cm in length. Infection results from larval penetration of the skin on contact with contaminated soil (Yaro, 2024). An intensely pruritic, erythematous, papulovesicular rash called ground itch can develop at the site of entry. Parasites then enter the venous or lymphatic circulation and travel to the lungs, at which point an urticarial rash with cough can develop. The larvae are swallowed and migrate to the small intestine, where they attach to the bowel wall with teeth or biting plates and take a continuous blood meal by sucking with strong oesophageal muscles (Bocca, 2015). As the larvae lodge in the small intestine, peripheral eosinophilia peaks and gastrointestinal discomfort with or without diarrhoea can result. Large oral ingestion of *A. duodenale* can cause Wakana syndrome, characterized by cough, shortness of breath,

nausea, vomiting, and eosinophilia (Brooker *et al*., 2004). The most important clinical manifestation of hookworm infection is iron-deficiency anaemia, which can be mild or severe and may be accompanied by the malabsorption of protein in hosts with a heavy burden of disease. Infants and pregnant women can become extremely ill or even die as a result of the anaemia. (Brooker *et al*., 2004).

Hookworm may be difficult to diagnose because light infections often do not produce enough eggs to be readily seen on stool examination; stool should therefore be concentrated if infection is suspected. Eggs do not appear in stool until approximately 2 months after dermal penetration *of N. americanus* and up to 38 weeks from cutaneous entry of *A. duodenale*; hence, patients with pulmonary complaints will not yet have a positive stool examination (Bocca, 2015) Multiplex PCR assays that detect *A. lumbricoides*, *T. trichiura*, and hookworm have a higher sensitivity than direct microscopy, however these are not as widely available yet. (Benthony *et al*., 2013,)

Necator americanus and *Ancylostoma duodenale* egg can be found in warm, moist soil where they eventually hatch into first stage larvae, or L1. L1 feed on soil microbes and eventually molt into second stage larvae, L2, L2 which is also like rhabdito form stage , feed for approximately 7 days and moult into the third stage, or L3. L3 is the filariform stage of the parasite, that is the non-feeding infective form or the larvae. When hookworm eggs are passed in the stool, under certain conditions (such as shade, moisture and warmth) the eggs will hatch over a period of 1 to 2 days (CDC, 2013).Humans typically become infected with hookworm when skin comes into contact with L3 larvae in the soil, although A. *duodenale* L3 have been shown to infect by both the skin and oral route (Hotez 2014). Hookworm is well adapted in their host base on the mode of feeding, temperature, andmoisture as reported by Rogen, 2016).

MATERIALS AND METHODS

Study Area

Mubi North is located in the North-Eastern Part of Nigeria, it lies between latitude 10˚ 06' "and 10˚ 29'N, Longitude 13˚ 07' and 13˚30'E. Mubi North local Government is found in Adamawa State which is surrounded by Mubi South, Maiha and Michika Local Government. People living in Muchalla are mainly farmers by occupation while some are involved in traditional activities such as blacksmith, poultry, hand waved cloth, wood carving, leather work and Zana matt etc.

The major ethnic group and language found in Muchalla is Fali. Some of occupations found in Muchalla are rearing of cattle, fishing, some mineral resources found in Muchalla are coal and Clay rocks. (Adebayo, *et al*; 2020) Fig 1.

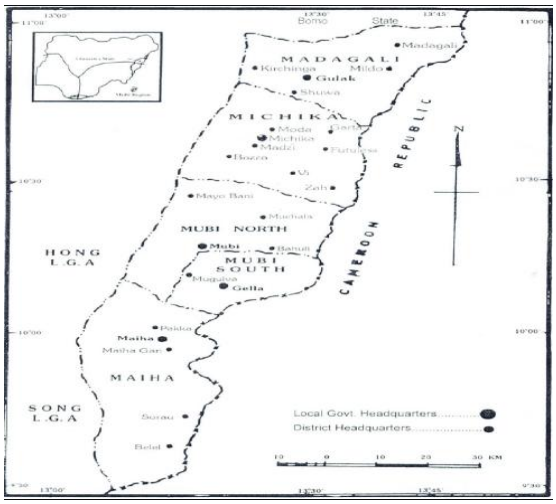

Figure 1: Map of Mubi North Local Government Area

Study Population

This study was carried out amongst the children of age 4-15 years in Muchalla Primary Shool, Mubi North Adamawa State.

Ethical and Consent Approval

Informed written consent was sought from the parents, caregivers and the school authority after explanation about the objectives and aim of the study.

Determination of Sample Size

A total of 120 pupils were sampled using the formula describe by Yamane, 1967.

$$n = \frac{N}{1+N \cdot e2}$$

n = Sample size

N - population size

e - level of precision or confidence

N=750

e = 0.05

$$n = \frac{750}{1 + 750.0.05^2} = 99.9$$

The sample size = 99.9. But was rounded up 120 for any misplacement or breakage of samples.

Sampling Techniques

The study was carried out amongst pupils aged 4-15 years in Muchalla Primary School, Mubi North LGA of Adamawa State using random sampling method.

Specimen Collection

A screw-capped, wide mouth container containing 10% formalin as preservative was given to each participant, with instructions on how to obtain fresh early morning stool sample. Each specimen bottle was labelled with pupil's details including their class, age and sex. The sample was transported in cool box containing ice to the Department of Zoology, Adamawa State University, Mubi laboratory for analysis.

Laboratory Analysis
Formal ether concentration technique by Arcari *et al. (*2000) and saline wet mount or direct stool microscopy by Abayome, (2007) were used for the parasitological examination of the stool samples.

Direct Microscopy Technique
Direct smear method for faecal examination was performed by:
i. Placing a drop of saline on one end of a clean grease free slide and at the other end place a drop of iodine.
ii. Using an applicator stick, a small amount of the faeces was emulsified in the saline and then the iodine.
iii. Cautiously and gently the smear was covered with cover slip avoiding air bubble and over flow of the samples. The smear was mounted onto a phase contrast microscope and examined under 10x and 40x objective lens. The intestinal parasites were identified on the basis of morphological characteristics as in Taylor *et al*. (2001).

Formal-Ether Concentration Method
Stool specimen was processed following a formal-ether standing operation procedure. Two grams (2 g) of faecal sample was transferred into a clean centrifuge tube containing 7ml of 10 percent formalin solution and mix thoroughly using vortex mixer. The suspension was filtered through one-millimetre (1mm) sieve into a 15ml centrifuge tube. Then 4ml of diethyl ether was added to the formalin solution to dissolves fat. The content was centrifuged at 3000rpm for 1 minute. The supernatant was discarded and smear was prepared using a slide from the sediment. Finally, the slide was examined under a microscope with magnification power of 10x and 40x objective lens for the presence of intestinal parasite (hookworm). The parasites (hookworm) were identified on the basis of morphological characteristics as described by Arcari *et al*. (2000).

Data Analysis
The data obtained in this study was statistically analysed using descriptive statistics and Chi-square test was used to evaluate the level of association between the age and sex.

RESULTS AND DISCUSSION

Result
Table 1 shows the prevalence of hookworm based on class. Out of 120 samples collected 26 were infected with 21.67% prevalence. Primary 5 recorded highest prevalence of 7(26.92%) followed by primary 4, 6(23.08%), while primary 6 recorded the least prevalence with 1(3.83%). Higher prevalence recorded in Primary 5 may be due to less concern given to them by either teachers or their parents as they are taught to be mature enough to take care of themselves. Chi-square test reveals a statistical difference at $p > 0.05$ value in the prevalence of hookworm among the classes.

Table 1: Prevalence of Hookworm Based on Class

Class	No. Examined	No. infected	Prevalencee df=2 (%)
Primary 1	16^{d}	5^{b}	19.23
Primary 2	24^{b}	3^{e}	11.54
Primary 3	22^{c}	4^{d}	15.38
Primary 4	29^{a}	6^{b}	23.08
Primary 5	13^{e}	7^{a}	26.92
Primary 6	16^{d}	1^{f}	3.83
Total	120	26	100
χ^2	15.30	10.75	
LOS	**	ns	

^{abcde} Means Having Different Superscripts on the Column are Statistically Different

Age- related prevalence of hookworm is shown in table 2 where the highest prevalence was recorded in age group 8-11 years with 46.15%, followed by aged group 4-7 years with 38.46% while age group 12-15 years recorded the least prevalence of 15.38%. Aged group 8-11 recorded the highest prevalence because they are highly independent and spend prolonged periods playing unsupervised outdoors without foot wares and often kneels or plays directly in dirt, giving hookworm larvae opportunity to pierce the skin.

Table 2: Prevalence of Hookworm Infection Based on Age of the Pupils

Age group (years)	No. Examined	No. infected	Percentage (%) df=2
4-7	46^{b}	10^{b}	38.46
8-11	48^{a}	12^{a}	46.15
12-15	26^{c}	4^{c}	15.38
Total	120	26	100
χ^2	6.06	20.06	
LOS	*	*	

^{abc} Means Having Different Superscript on the Column are Statistically Different

Table 3 shows the prevalence of hookworm based on sex, 65 males were examined out of which17 (65.38%) were confirmed to be infected and out of 55 females examined 9 (34.62%) were confirmed to be infected with Hookworm. Males recorded the highest prevalence because they are more expose to places where they may be easily infected and by their mode of playing with water bodies and walking bare footed because less attention is paid to them by their parents and teachers.

Table 3: Prevalence of Hookworm Infection Based on Sex of the Pupils

Sex	No. Examined	No. infected	Percentage df=2 (%)
Male	65[a]	17[a]	65.38
Female	55[b]	9[b]	34.62
Total	120	26	100
χ^2	6.06	20.06	
LOS	*	*	

[ab] Means Having Different Superscript on the Column are Statistically Different

Discussion

The overall prevalence of 21.67% was recorded out of 120 pupil examined which was above 5.3% reported by Dangana *et al.,* (2011)in Ayamelum local government area of Anambra Sate; 10% reported by Godwin *et al.,* (2011) in staff school Federal Polytechnic Mubi and 14.7% reported by Hailu *et al.,* 2019 in Jawe district, Northwest Ethiopia among school age children but was lower than that of Aribodor *et al.,*(2025) who recorded 35.2% in Anambra State, Nigeria This may be due to parent occupation, because most of the parents are highly educated, living in a good building and water supply environment compare to villages and the use of toilet (Keller Heather *et al.,* 2012). Table 1 shows that Primary 5 recorded highest prevalence 7(26.92%) followed by primary 4(23.08%), while primary 6 recorded the lowest prevalence with 1(3.83%). Higher prevalence recorded in Primary 5 may be due to less concern given to them by either teachers or their parents as they are taught to be mature enough to take care of themselves. The result of this study showed that Hookworm is prevalent in Muchala Primary School, Mubi North Local Government Area and active transmission could be going on. The higher prevalence of hookworm observed among individuals in this school could be attributed to children playing barefooted and open defication. The prevalence of the disease may have been enhanced by penetration of larvae, eating unwashed vegetables and fruits and contaminated soil environment, Alemu *et al.,* (2019.The high incidence of the disease could also be attributed to conducive environmental condition such as temperature, rainfall, moist soil, nature of soil and human factors like open defecation, application of faeces as fertilizers in the community which promote the transmission of diseases. Similar observation was made by Elkanah *et al.,* (2011) who agreed that the variation observed among the communities could be due to different ecological conditions that favours the parasite. Age-related prevalence is as shown in table 2. The highest prevalence was recorded in age group 8-11 years with (46.15%), followed by age range 4-7 years (38.46%) while age group 12-16 years recorded the least prevalence (15.38%) respectively. Table 3 showed the prevalence of Hookworm based on sex. A total of 65 males were examined out of which 17(65.38%) were confirmed to be infected while out of 55 females examined 9(34.62%) were confirmed to be positive for Hookworm infection. Males recorded the highest prevalence of hookworm infection because they are more expose to places where they may be easily infected, and by their mode of playing with water and walking bear footed, because less attention is paid to them by their parents this disagrees with the report of Ezeaguna *et al.* (2010) who reported a very high prevalence rate of hookworm infections among females than males' school pupils in Ozobulu and Ebenebe town in Anambra State. This may be due to in-proper hygiene and also as a result of ignorance, poor environmental condition, in-adequate washing of hans and fruits. It is obvious that people who are poor or do not use foot ware are at most risk of infection by Hookworm.

CONCLUSION

We conclude, that Hookworm infection was prevalent in Muchalla primary school Mubi North Local Government Area and that primary 5 recorded higher prevalence with males having the highest rate of infection while age group 8-11 and 4-7 were more infected in both sexes. Based on the research findings, we therefore recommend that; Water, sanitation and hygiene (WASH) programme should be introduce in the study area, and that government and school management should health educate and encourage programmes that would expose the community and the pupils to hygiene practices to prevent the infection by hookworms.

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CONFLICT OF INTEREST

The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

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