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Mukhtar Adamu Muhammad
Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Maryam Mohammed Yerima
Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Asogwa Cullet Ifeyinwa
Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Udo Francis Japhet
Department of Biological Sciences, University of Calabar, Cross River, Nigeria

Fatima Muhammad Kabir
Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Corresponding Author:
Mukhtar Adamu Muhammad
Department of Biological Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Prevalence of geo-helminths parasites among private and public school pupils in Bauchi State, Nigeria

Mukhtar Adamu Muhammad, Maryam Mohammed Yerima, Asogwa Cullet Ifeyinwa, Udo Francis Japhet and Fatima Muhammad Kabir

Abstract
Background: Geo-helminth parasites pose significant public health concerns due to their detrimental impact on nutritional status. This study aimed to investigate the prevalence of geo-helminth parasites among school pupils in the study area, considering age and gender, and comparing public and private school pupils.
Methods: Two hundred stool samples were collected and examined microscopically using direct wet smear and zinc floatation techniques.
Results: Out of the 200 samples, 72 (36%) tested positive for geo-helminth parasites. Males showed a higher prevalence (38%, 19%) than females (34%, 17%). Ascaris lumbricoides was the most common parasite (30%, 15%), followed by *Necator americanus* (18%, 9%), *Strongyloides stercoralis* (14%, 7%), and *Trichuris trichiura* (10%, 5%).
Conclusion: This study highlights the need for urgent measures, including anthelmintic treatment, health education, mass chemotherapy, and improved sanitary facilities in schools and public areas.

Keywords: Nigeria, soil-transmitted helminths, geo-helminths, zinc floatation, public areas

1. Introduction
Soil-transmitted helminths (STH) are a group of parasites that infect humans through contact with contaminated soil (Hong *et al*., 2006) [1]. These parasites thrive in warm and moist soil, common in tropical and subtropical regions (Beasley *et al*., 2000) [2]. The life cycle of STH involves the soil receiving non-infective stages, providing conditions for development into infective stages, and protecting the infective stages until they come into contact with a susceptible individual (Bethony *et al*., 2013) [3].
STH infections cause significant morbidity in endemic areas, affecting growth, nutrition, and cognition, ultimately disturbing school performance (WHO, 2015) [4]. The most prevalent STH globally are roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Necator americanus* and *Ancylostoma duodenale*) (Phiri *et al*., 2000) [5]. These parasites have infected an estimated 1.2 billion, 800 million, and 740 million people, respectively (Crompton *et al*., 2011) [6].
In Nigeria, the most populous country in Sub-Saharan Africa, STH infections are endemic due to favorable edaphic and climatic conditions, inadequate sanitation, and poor nutrition (Horton *et al*., 2003) [10]. This study aims to investigate the prevalence of geo-helminths parasites among private and public school pupils in Bauchi Metropolis, focusing on the impact of these infections on nutritional status.

2. Methods
2.1 Study area and population
Bauchi State, located in northeastern Nigeria, covers an area of 49,119 km² and has a population of 4,653,066 people, according to the 2006 census. The state's rainfall patterns vary, with the southern part receiving more rainfall than the northern part. The study sites included Unguwar Barno Primary School and Baitul Hikmah Nursery and Primary School, representing public and private schools, respectively.

2.2 Ethical clearance
Ethical approval was obtained from the Health Research Ethics Committee of the Bauchi State Ministry of Health. Informed written consent was obtained from participants, parents, or caregivers, and assent forms were obtained from children aged 7-14 years.

2.3 Study design and sample collection
Fresh stool samples were collected from preschool children and transferred to the laboratory for analysis. A wet preparation was made using normal saline, and the samples were observed for gastrointestinal helminth eggs or ova using a microscope. The Zinc sulphate ($ZnSO_4$) method was also used for analysis.

2.4 Laboratory procedure of stool sample
A wet preparation was made by emulsifying stool sample with few drop of normal saline on a grease-free slide as described by Cheesbrough (2006) [33]. The slide was then observed for the eggs or ova of gastrointestinal *helminthes* using the ×10 or ×40 objective lens. Additionally, the Zinc sulphate ($ZnSO_4$) floatation method was employed, as described by Silue Knopp *et al.* (2010) [34], to concentrate and detect the eggs or ova.

3. Results and Discussion
The results showed that 72 (36%) out of 200 stool samples were positive for geo-helminths parasites, including *Ascaris lumbricoides*, *Necator americanus*, *Trichuris trichiura*, and *Strongyloides stercoralis*. The prevalence of these parasites varied according to age group, sex, and location.

3.1 Prevalence of geo-helminths parasites among public and private school pupils: The study found a higher prevalence of parasites in public school pupils (61.1%) compared to private school pupils (38.9%), Table 1.

3.2 Prevalence of geo-helminths parasites species in relation to schools
Ascaris lumbricoides was found to have a higher prevalence in public schools (2027.8%) than in private schools 10(14.0%). *Necator americanus* and *Strongyloides stercoralis* had equal prevalence in both schools, while *Trichuris trichiura* had a higher prevalence in public schools (12.5%) than in private schools (9.7%), Table 2.

3.3 Prevalence of geo-helminths parasites species in relation to age in the study area
Children aged 0-5 had the highest prevalence of *Ascaris lumbricoides* 8(11.1%), followed by those aged 10-11 5(6.9%), and 6-7 2(2.8%). Were the least of parasitic infections, Table 3.

3.4 Prevalence of geo-helminths parasites species between sexes
Males in public schools had a higher prevalence of 23(31.9%) than their female's counterpart accounting for 21(29.2%), while males in private schools had a lower prevalence of 15(20.8%) and females 13(18.1%) compared to public schools. Males had a higher prevalence of all four parasites species than females, Table 4.

For Table 1

Table 1: Prevalence of geo-helminths parasites species among public and private school

School	No. of samples examined (N=200)	No. of samples infected (N=72)	Prevalence (%)
Private school	**100**	**28**	**38.9%**
Public school	**100**	**44**	**61.1%**

Key: A = Baitul Hikma College, B = Unguwar, Borno Primary School

For Table 2

Table 2: Distribution of specific geo-helminth species among pupils in public and private schools, highlighting higher prevalence of Ascaris lumbricoides in public schools compared to private schools, with comparable rates for other helminth species

School	*A. lumbricoides* (N=30)	*T. trichuiria* (N=10)	*N. americanus* (N=18)	*S. stercoralis* (N=14)
Private school	10 (14.0%)	2 (2.7%)	9 (12.5%)	7 (9.7%)
Public school	20 (27.8%)	8 (11.1%)	9 (12.5%)	7 (9.7%)

Key: Private school (Baitul Hikmah College), Public school (Unguwar Borno primary school)

Table 3: Prevalence of geo-helminths parasites species in relation to age in the study area

School age group	*A. lumbricoides* (N=30)	*T. trichuria* (N=10)	*N. americanus* (N=19) *Stercoralis* (N=14)	S.
Private				
0-5	3(4.2%)	**00**	2(3.0%)	1(1.4%)
6-7	2(2.8%)	00	2(3.0%)	2(3.0%)
8-9	2(3.0%)	1(1.4%)	2(3.0%)	2(3.0%)
10-11	3(4.2%)	1(1.4%)	4(5.6%)	2(3.0%)
Public				
0-5	8(11.1%)	2(2.8%)	5(6.9%)	2(3.0%)
6-7	2(3.0%)	1(1.4%)	2(2.8%)	2(3.0%)
8-9	5(6.9%)	2(2.8%) 1(1.4%)	1(1.4%)	
10-11	5(6.9%)	3(4.2%) 2(3.0%)	1(1.4%)	

Key: Private school (Baitul Hikmah College), Public school (Unguwar Borno primary school)

Table 4: Prevalence of geo-helminths parasites species between sexes

School	Parasites Species	Male (N=38) %	Female (N=34) %
Private	*A. lumbricoides*	6(8.3%)	4(5.6%)
T. trichuiria	1(1.4%)	1(1.4%)	
N. americanus	5(6.9%)	4(5.6%)	
S. stercoralis	3(4.2%)	4(5.6%)	
Public	*A. lumbricoides*	13(18.1)	7(9.7%)
T. trichuiria	2(2.8%)	6(8.3%)	
N. americanus	4(5.6%)	5(6.9%)	
S. stercoralis	4(5.6%)		3(4.2%)

Key: Private school (Baitul Hikmah College), Public school (Unguwar Borno primary school).

4. Discussion

The present study found no unusual geo-helminths parasites or soil-transmitted infections, consistent with reports from various workers (Hong *et al*., 2006) [1]. The prevalence of *A. lumbricoides, N. americanus, T. trichuiris,* and *S. stercoralis* followed the same trend in both public and private schools, agreeing with the report of Ceilia *et al*. The prevalence of these infections in all age groups was similar to that in several other communities in Nigeria (WHO, 2015) [4]. The high prevalence of infection in children could be attributed to their behavior of playing in contaminated environments and eating indiscriminately with unwashed hands (Vercruysse *et al*., 2011) [14]. Males were found to be slightly more infected with geo-helminths parasites than females, attributed to their increased contact with soil (Levecke *et al*., 2010) [36]. The socioeconomic status of parents, particularly farmers, was found to be a risk factor for infection (Singh *et al*., 2018) [13]. Poor environmental and personal hygiene were also identified as driving forces of STH infection (Beaver *et al*., 2014) [8].

5. Conclusion

The study revealed a high prevalence of geo-helminths parasites species in public school pupils compared to private school pupils. Ascaris lumbricoides eggs were the most numerous, followed by hookworms (*N. americanus*), *S. stercoralis*, and *T. trichuira*. The study highlighted the relationship between the prevalence of geo-helminths eggs and variables such as toilets, hand washing, finger nail trimming, shoe wear, and washing fruits before eating. The findings suggested that males have a higher prevalence of intestinal parasites than females. The study recommended periodic treatment of children with intestinal parasites using broad-spectrum or multi-agent drug combinations, provision and improvement of sanitary facilities in schools, and consistent intervention strategies targeted at the parasites.

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