Prevalence and Socio-Economic Factors of Human Intestinal Helminth Infections amongst Primary School Pupils in Bokkos, L.G.A, Plateau State

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DOI: https://doi.org/10.51584/IJRIAS.2025.1001005

Received: 21 December 2024; Accepted: 30 December 2024; Published: 28 January 2025

ABSTRACT

Intestinal helminth infections remain a significant public health challenge, particularly in low-resource settings where poor sanitation and hygiene practices prevail. This study was conducted in Bokkos Local Government Area of Plateau State to ascertain the prevalence and socio-economic factors of intestinal helminth infections amongst primary school pupils. Cross-sectional descriptive research design *and multi*-stage sampling technique were used to collect stool samples from 100 pupils, aged 3–13 years. *A close-ended pre-tested structured questionnaire was used to obtain responses from 100 respondents. Samples were analysed using* sedimentation, direct smear and flotation method. Results revealed a high overall prevalence of intestinal helminth infections 76 (59.9%). The most prevalent helminth specie was Hookworm 27(19.1%), followed by *Ascaris lumbricoides* 23(17.9%), *Trichuris trichiura* 15(14.2%) and *Strongyloides stercoralis* 11(8.7%) respectively. However, there was statistical difference in the prevalence of Specific Intestinal Helminths infection among pupils (P<0.05). There was a statistical difference between sex of pupil and intestinal helminth infections (P<0.05). More females 42(42.0%) were infected than males 34(34.0%). There was a statistical difference between age of pupil and intestinal helminth infections (P<0.05). The highest infection rate, 28(28.0%) was observed in pupils within age group 3 - 6 while the least infection rate 13(13.0%) was observed in the age group 13 and above. There was a statistical difference in the prevalence of intestinal helminths infection among pupils in relation to age (P<0.05**).** There was a significant association between socio-economic factor and the prevalence of intestinal Helminth infections among Pupils (P<0.05). There was also a significant difference between the risk factors of intestinal helminth infections among pupil (χ^2 = 0.109, df = 2, P = 0.021). Conclusively, the high prevalence rate of intestinal helminths among primary school pupils within the study area significantly affects their academic achievement and overall wellbeing. It is therefore recommended that routine deworming programs should be provided by the government with administration of anti-helminthic drugs complemented by monitoring and evaluation mechanisms to assess its effectiveness in reducing infection rates.

Key Words: Prevalence, Socio-Economic Factors, Intestinal Helminths, Bokkos

INTRODUCTION

Intestinal helminth infections, commonly known as worm infections, are parasitic diseases caused by various species of helminths, including roundworms, hookworms, and whipworms. These infections are prevalent in many parts of the world, especially in regions with poor sanitation and inadequate access to clean water. Helminth infections can have significant health implications, particularly for children, affecting their nutritional status, cognitive development, and overall quality of life (Alemu**,** 2019). The infection was ranked highest in morbidity rate among school aged children who often present with much heavy worm infections because of their vulnerability to nutritional deficiency (Eneanya and Njom, 2016). Ova of helminths can also be isolated on the underneath of fingernails of these children (Gyang, 2017) and on the surface of the Nigerian currency notes which they handle and also leak (Ekejindu, 2018). These infections are of major public health concerns because factors that predispose man to the infections are bound in the sub-region which include poor environmental hygiene, poverty, malnutrition and ignorance (Ijagbone, 2019).

In recent years, the prevalence of intestinal helminth infections has been well studied in the various African countries. These studies focused mainly on the prevalence of intestinal helminth infections among primary school pupils and gradually extended into the socio-economic factors of these infections among the children (Ekpenyong and Eyo, 2015; Muniz, 2018; Oblukwu *et al*., 2018; Ezeagwuna *et al*., 2019). According to studies, helminth infections are widespread in Africa with high prevalence rate in Nigeria, Ivory Coast, Angola, New Guinea, Rhodesia and Kenya (Muniz, 2018). In 2008, Anosike, *et al*., recorded that in a world of 2,200 billion inhabitants, there existed over 2,000 million helminth infections with about 1.5 million Nigerians suffering from *Ascariasis* alone, while there are several thousand with *Strongyloidiasis, Trichuriasis, Enterobiasis* and Hookworm infections. The high prevalence rate of intestinal helminth in Nigeria, especially among primary school children was confirmed by Dada-Adegbola and his colleagues who recorded 68.2 % prevalence rate of intestinal helminths from stool samples of Children aged 0-7 years (Dada-Adegbola *et al*., 2019). Globally, intestinal helminth infections are a major public health concern, with the World Health Organization (WHO, 2016) estimating that over 1.5 billion people are infected. This burden is disproportionately high in Low- and Middle-Income Countries (LMICs), where socio-economic and environmental factors contribute to the spread and persistence of these infections. In sub-Saharan Africa, including Nigeria, helminth infections are widespread, with children being the most vulnerable group due to their frequent exposure to contaminated environments and their developing immune systems (Nwosu**,** (2020).

In Nigeria, the prevalence of intestinal helminth infections varies across different regions and is influenced by factors such as climate, hygiene practices, and socio-economic status. The country's diverse geography and socio-economic disparities create a complex landscape for the control and management of these infections (Omudu and Amuta, 2017). Bokkos L.G.A, Plateau State, located in the North-Central region of Nigeria, is one of the areas where these infections remain a significant health issue, particularly among school-aged children. The area's socio-economic profile is characterized by limited access to healthcare facilities, poor sanitation, and low income levels. These conditions create an environment conducive to the transmission of intestinal helminthes (Gyang, 2017). Children between the ages of 4 and 16 have been reported by different researchers to have the highest prevalence rate. They are the most vulnerable age group among school children (Ekpenyong and Eyo, 2015; Oblukwu *et al*., 2018; Ezeagwuna *et al*., 2019). Among primary school children were reported heavy worm infections and the researchers stated that it is because they were vulnerable to malnutrition deficiency (Bethony *et al*., 2016). Also, the use of bushes, streams and pit latrines for defecation has been reported to increase the prevalence rate of helminths infections in pupils than the use of water cistern. As a result of poor hygiene, has been found that the Nigerian currency notes, which the primary school children handle and lick, harbour the ova of helminths (Gyang, 2017).

Prolonged nutrient deprivation due to helminth infections can lead to stunted growth (short stature) and wasting (low weight for height). Children may appear smaller and thinner than their peers, with impaired physical development. Children may struggle with academic performance and exhibit signs of attention deficit and hyperactivity (Jangmo, 2019). Persistent health issues and the social stigma associated with visible symptoms like passing worms or a distended abdomen can lead to stress and anxiety in children. This can affect their emotional well-being and social interactions. The physical manifestations of infection and the impact on academic performance can contribute to low self-esteem and self-worth, further complicating their psychological health (Arshad, 2015).

Bokkos Local Government Area in Plateau State is predominantly rural and faces numerous socio-economic and environmental challenges that facilitate the transmission of intestinal helminthes (Gyang, 2017). Primary school pupils in this region are at high risk due to their regular contact with contaminated soil and water and the lack of adequate sanitation facilities both at home and in schools. These conditions not only increase their susceptibility to infections but also contribute to a cycle of poverty and poor health outcomes that affect their educational performance and overall quality of life. Despite the well-documented prevalence of helminth infections in various parts of Nigeria, there is a significant gap in localized research specifically targeting Bokkos Local Government Area of Plateau State. However, comprehensive data on how these factors interact

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

within the context of Bokkos Local Government Area is lacking (Gyang, 2017). This study aims to fill this gap by investigating the prevalence and socio-economic factors of human intestinal helminth infections among primary school pupils in Bokkos LGA and exploring the socio-economic factors that contribute to these infections. Findings from this study will give adequate knowledge on how to reduce infection rates among pupils which will likely lead to higher attendance rates, as children are less likely to miss school due to illness.

MATERIALS AND METHOD

Study Area

The study was carried out in Bokkos Local Government Area of Plateau State, Nigeria. Its headquarter is in the town of Bokkos located within latitude 9°18′00″N and longitude 9°00′00″E. It has an area of 1,682 km^2 and a population of 178,454 at the 2006 census. Bokkos Local Government has eight districts which are Bokkos, Mushere, Daffo, Sha, Manguna, Richard, Toff, and Kamwai. There are 20 electoral wards in Bokkos. Bokkos Local Government major tribes are Ron, Kulere and Mushere. The Paramount ruler of Bokkos is called saf Ron/Kulere (NPC, 2007). Bokkos, is always warm, partially cloudy during the dry season, and muggy and overcast during the wet one. The average annual temperature fluctuates between 54°F and 89°F; it is rarely lower or higher than 49°F or 93°F. The 2.7-month hot season, which runs from January 28 to April 18, it has daily highs that average more than 85°F. With an average high temperature of 89°F and low temperature of 63°F, March is the hottest month of the year in Bokkos (NPC, 2007). Summertime temperatures above 76°F are rare during the 3.5-month-long cold season, which runs from June 27 to October 10. August, with an average low temperature of 61°F and high temperature of 72°F, is the coldest month of the year in Bokkos. Bokkos LGA has an average annual temperature of 25 degrees Celsius and is spread across 1,682 square kilometers. Bokkos LGA has an average humidity of 55% and an average wind speed of 14 km/h (NPC, 2007). Throughout the year, there is a noticeable seasonal change in the average percentage of cloud cover in Bokkos. In Bokkos, the clearest portion of the year lasts 3.8 months, starting about November 5 and ending around February 29. January is the clearest month of the year in Bokkos, with 53% of the sky being clear, mostly clear, or partly overcast on average. About November 5, the cloudier portion of the year ends. It starts about February 29 and lasts for 8.2 months. May is the cloudiest month of the year in Bokkos, with the sky being overcast or largely cloudy 85% of the time on average (NPC, 2007). The L.G.A is dominated by both Christians and Muslims who engages majorly in business, farming and other agricultural activities.

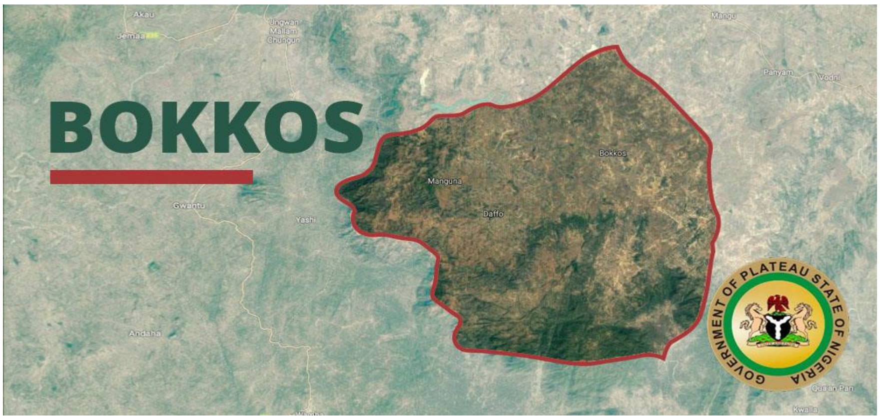

Fig 1: Map of Bokkos Local Government Area

Informed Consent

Consent was sought from the different school heads before distributing the questionnaires. An introduction letter was gotten from the Head of Department Biology, Federal University of Education Pankshin to the various schools under study. A written note was given to the parents to seek their consent for the questionnaire to be filled by their child/ward.

Research Design

This study employed a cross-sectional descriptive research design. The cross-sectional nature of the study

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

allowed for the collection of data at a single point in time from a representative sample of the population**.** Multi stage sampling technique was employed.

Study Population

The target population for this study comprised of male and female pupils from five (5) randomly selected public primary school between the ages 4-13years of age in Bokkos Local Government Area. Pupils from both urban and rural schools were included in the sample to provide a comprehensive overview of the prevalence of intestinal helminths across different socio-economic and environmental conditions. This population is particularly susceptible to intestinal helminths infections due to poor sanitation, inadequate water supply, and frequent outdoor activities that increase exposure to contaminated soil and water.

Sampling Techniques

A multi-stage sampling technique was employed in this study with the combination of random sampling technique for selection of schools to ensure representation across various schools and pupils from each selected school were randomly chosen for participation. This method ensured that each child had an equal chance of being included in the study, thereby minimizing selection bias and enhancing the generalizability of the results. The multi-stage sampling technique became the most appropriate sampling technique since it enables the researcher chose his subjects in stage, using a particular sampling method in each stage, until the required sample was obtained.

Method of Sample Collection

A total of 100 stool samples were collected from five (5) randomly selected public primary schools (20 pupils per school) in Bokkos Local Government Area. Clean stool containers were given to pupils to collect stool samples and return the next morning with name, age and sex inscribed on the stool containers. Pupils were instructed on how to collect small quantities of their stool into the container using a wooden applicator stick to avoid contamination of feaces with Urine or any other contaminants. The feacal specimens were preserved with 10% formalin. All collected samples were taken to Standard Medical laboratory Pankshin for laboratory examination.

Table 1: Schools for sample collection

S/N	**SCHOOLS**	**SAMPLE**
1.	LGEA Primary School Daffo	20
2.	LGEA Primary School Butura Kampani	20
3.	Central Primary School Masharkut	20
4.	LGEA Primary School Dashorom Bokkos	20
5.	LGEA Primary School Marish	20
TOTAL		**100**

Administration of Questionnaires

A total of 100 well-structured questionnaires were self-administered with help of their school teachers to collect the socio-demographic information on each pupil in their local language and their responses were recorded by underlining the appropriate options provided. The infection contained in the questionnaire includes pupil's bio-data, sanitation, school environment, parent's occupation as well as their prevalence and socio-economic factors of intestinal helminth infections. A total number of 100 questionnaires were distributed and returned.

Methods of stool analysis

This was done at the department of Parasitology and Entomology laboratory. The parasitological techniques used are; direct smear method, sedimentation method, Zinc sulphate floatation method.

Direct Smear Method

A drop of normal physiological saline and standard Lugo's Iodine each was placed on one side of a clean grease-free glass slide and a tiny stool sample of about 2mg was collected using an applicator stick. This was emulsified into the drop of normal saline on the slide and the same way into the drop of Lugo's iodine with a different applicator stick unto a homogeneous smear is obtained. This was covered with cover slip to avoid trapping air bubbles on the slide. Prior to this, each slide was labelled with pupil's unique identification number at the edge with masking tape. The preparations were then examined under the microscope using X10 to focus whileX40 objective lens was used to magnify and identify the parasite and eggs.

Sedimentation Technique

The laboratory apparatus used for this procedure are: sieve, beaker, centrifuge, coverslip, glass slide and normal saline, Lugol's iodine and microscope.

Procedure:

Normal saline used for sedimentation was prepared. Two grams of stool sample was added to the beaker and few drops of normal saline were added and mix vigorously, sieve was used to filter in another beaker and the filtrate was added into the centrifuge tube. The sample was centrifuge at 2500 revolution per minutes for 3 minutes, and the supernatant was decanted. A drop of the filtrate was added to the glass slide with a drop of lugol's iodine and was covered with cover slip. It was viewed under the microscope at X10 and X40 objective lens. (Garcia, 2001).

Zinc Sulfate Flotation Technique

In flotation technique, Zinc sulfate solutions are normally used because they have low specify gravity and these allows egg of parasite to float. Laboratory apparatus used: sieve, cover slip, glass slide, test tube, funnel and microscope.

Procedure: Zinc sulfate solution was prepared, 2g of stool sample was added to the beaker and 5ml of zinc sulphate were also added and mix vigorously. Sieve was used to filter in another beaker and the filtrate was transferred to a test tube using a funnel. The test tube was filled to the brim with the zinc sulfate and was covered with cover slip. It was allowed to settle for 30 minutes. A drop of lugol's iodine was added to the glass slide and that coverslip was placed in the glass slide. It was viewed under microscope at X10 and X40. (CDC, 2016).

Validity and Reliability of the Instrument

Validity: The validity of the instrument was ensured by adopting standard parasitological methods, which are recognized for their effectiveness in diagnosing intestinal helminths. Furthermore, stool samples were collected and analyzed by trained laboratory technicians to minimize human error and ensure accuracy in helminth identification. The instruments were also validated by experts in field of parasitology in the department; this is to ensure that they accurately measured the prevalence of helminths among the study population.

Reliability: Reliability was achieved through consistency in the data collection and analysis process. The stool analysis techniques were standardized, and multiple technicians independently examined a subset of samples to ensure consistency in results. Any discrepancies in findings were resolved through further consultation with experts, and procedures were adjusted where necessary to maintain reliability. The pilot study also helped refine the instrument, ensuring its reliability in the main study.

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Data Analysis

The data c ollected in this study was arranged in tables and analyzed using simple percentage, statistical mean. Demographical characteristics of the respondent were analyzed using percentages. The response collected from the respondents on the research problem was analyzed using statistical mean. The Chi-square was used to test the hypothesis and to measure the significant difference between variables. The level of significant was identified as $P \leq 0.05$.

The formula of statistical mean is;

Mean Score: $\bar{x} = \frac{\sum FX}{N}$

Where: $\bar{x}$ = Mean

$\sum$ = Summation

F = Frequency

X = Variables of the study

N = Sample size

The formula for simple percentage is given as:

SP = $\frac{FX}{N} X \frac{100}{1}$

Where: SP= Simple percentage

FX = Frequency of responses

N = Total number of responses

The formula for the correlation of hypotheses given as

$X^2 = \Sigma \frac{(fo-fe)2}{fe}$

Where:

$\sum$ = Summation

F_o= Frequency Observed

F_e = Frequency Expected

X^2 = is the chi-square value

RESULT

Table 1: Prevalence of Specific Intestinal Helminths infection among primary school pupils in Bokkos Local Government Area of Plateau State

Type of Helminth Found	**Frequency**	**No of Positive (%)**	**Chi-Square**	**Df**	***P-value***
Ascaris lumbricoides	415	23(17.9%)			

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Hookworm	359	27(19.1%)	0.00[a]	1	0.000
Trichuris trichiura (Taenia specie)	497	15(14.2%)			
Strongyloides stercoralis	290	11(8.7%)			
Total	**1561**	**76(59.9%)**			

Table 1 above shows the prevalence of specific intestinal helminths infection among primary school pupils in Bokkos Local Government Area of Plateau State. Out of 100 samples that were tested, 1561 different species of Helminth parasites were observed out of which four different intestinal helminths parasites were detected; the result shows that the highest Helminth parasite observed was *hookworm* 23(17.9%), followed by *Ascaris lumbricoides*, 23 (17.9%), *Trichuris trichiura* 15 (14.2%) and *Strongyloides stercoralis* 11(8.7%) respectively. The result clearly shows a statistical difference between parasites found and intestinal helminth infections (P<0.05).

Table 2: Prevalence of intestinal helminths infection among primary school pupils in relation to age in Bokkos Local Government Area of Plateau State:

Age	Infected %	Non- infected %	Chi-square	Df	*P-value*
3 – 5	28(28.0)	8(8.0)			
6 – 8	19(19.0)	5(5.0)	0.000[a]	1	0.000
9 – 12	16(16.0)	7(7.0)			
13 – above	13(13.0)	4(4.0)			
TOTAL	**76(76.0)**	**24(24.0)**			

The above result shows the age specific prevalence of intestinal helminths infection among primary school pupils in Bokkos Local Government Area of Plateau State. The result revealed that out of 100 stool samples collected, 76(76.0%) samples were infected with helminth parasites while 24(24.0%) were not infected. Among age groups 3-5, 6-18, 9-12 and 13-above, 28(28.0%), 19(19.0%), 16(16.0%) and 13(13.0%) were infected respectively. Age group 3-5yrs had the highest rate of infection while age 13-above has the least rate of infection. However, there was a statistical difference between age of pupil and intestinal helminth infections (P<0.05).

Table 3: Prevalence of intestinal helminths infection among primary school pupils in relation to gender in Bokkos Local Government Area of Plateau State.

Gender (Sex)	Infected %	Non- infected %	Chi-square	Df	*P-value*
Male	34(34.0)	9(9.0)	0.000[a]	1	0.000
Female	42(42.0)	15(15.0)			
TOTAL	**76(76.0)**	**24(24.0)**			

The result in table 3 above shows the prevalence of parasites in relation to gender (sex) in Bokkos Local Government Area of Plateau State, it reveals that out of 100 pupils 76.0% were infected while 24.0% were not infected. Out of 76.0% infected pupils, 34.0% of them were males, and 42.0% of children were females. This

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indicates that female children had the highest prevalence of intestinal helminths infection compared to male children in Bokkos Local Government Area of Plateau State. However, there was a statistical difference between sex of pupil and intestinal helminth infections (P<0.05).

Table 4: Respondents response on the occupation of pupil's parents/guardians in Bokkos Local Government Area of Plateau State

Socio-economic factor	Infected %	Non- infected %	Chi-square	Df	*P-value*
Farmer	26(26.0)	10(10.0)			
Trader	20(20.0)	4(4.0)	0.000[a]	1	0.000
Civil servant	8(8.0)	3(3.0)			
Artisan	22(22.0)	7(7.0)			
TOTAL	76(76.0)	24(24.0)			

Table 4 above shows the Respondent's response on the occupation of the Pupil's Paraents/Guardians in Bokkos, L.G.A, Plateau State (representing the effects of socio-economic factors on the prevalence of intestinal Helminth infections among pupils). Out of 76(76.0%) infected pupils, 26(26.0%) of the Parents/Guardians were Farmers, 20(20.0%) of their parents were Traders, 8(8.0%) of the Parents/Guardians were Civil Servants while 22(22.0%) of the Parents/Guardians were Artisans. Pupils whose Parents/Guardians are Farmers were more infected 26(26.0%) followed by Pupils whose Parents/Guardians are Traders 20(20.0%), Civil Servants 8(8.0%) and Artisans 22(22.0%) respectively. However, There was no significant association between the occupation (socio-economic factor) of the parents and the prevalence of intestinal Helminth infections among Pupils in Bokkos L.G.A, Plateau State P<0.05).

Table 5: Respondents response on the risk factors of intestinal helminths infection among primary school pupils in Bokkos Local Government Area of Plateau State:

Risk Factors	Category	Intestinal Helminths in Pupils		Total
		Yes (%)	No (%)	(%)
Source of drinking water supply:	Borehole	4 (4.0)	3 (3.0)	7(7.0)
	Well	6 (6.0)	4 (4.0)	10(10.0)
Type of latrine/toilet:	Pit latrine	5 (5.0)	4 (4.0)	9(9.0)
	Open defecation	4 (4.0)	6 (6.0)	10(10.0)
How often do you take deworming tablets?	Months/6months intervals	6 (6.0)	3 (3.0)	9(9.0)
	Yearly	3 (3.0)	4 (4.0)	7(7.0)
	Not at all	2 (2.0)	2 (2.0)	4(4.0)
Do you always wash your hand before and after eating?	Yes	5 (5.0)	6 (6.0)	11(11.0)
	No	5 (5.0)	3 (3.0)	8(8.0)
Do you wash your fruits and vegetables before	Yes	4 (4.0)	2 (2.0)	6(6.0)

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consumption?	No	3 (3.0)	3 (3.0)	6(6.0)
History of bloody stools:	Yes	5 (5.0)	3 (3.0)	8(8.0)
	No	2 (2.0)	3 (3.0)	5(5.0)
Total		**54 (54.0)**	**46 (46.0)**	**100(100)**

χ^2 = 0.109, df = 2, P = 0.021

Table 5 above reveals the Respondents response on the risk factors of intestinal helminths infection among school pupils in Bokkos L.G.A, Plateau State. Out of 100 respondents, 54(54.0%) had a yes answer while 46(46.0%) had a No answer to the risk factors of intestinal helminth infection. 4(4.0%) of the pupils use borehole as a source of drinking water while 6(6.0%) use well water. 5(5.0%) of the Pupils use pit latrine while 4(4.0%) defecate openly in bushes and farms, 5(5.0%) do not wash hands before eating, 3(3.0%) and do not wash fruits and vegetables before consumption . However, there was a significant difference between the risk factors of intestinal helminth infections among pupil (χ^2 = 0.109, df = 2, P = 0.021).

DISCUSSION

In this study, an overall high prevalence of 76(59.9%) was observed which is comparable but much higher than the resuts obtained by Ezeagwuna *et al.*, (2009) on the prevalence and Socio-Economic factors of intestinal Helminth infections among primary school pupils in Ozubulu, Anambra State, Nigeria and observed 69.23% positive for various intestinal helminthes. The high prevalence of intestinal parasites in primary schools in Bokkos Local Government Area Plateau State could be due to favourable climate for the survival of the parasites coupled with improper management of organic refuse and inadequate supply of clean water; unavailability of potable water in some schools might drive pupils into other unhygienic sources, thereby exposing them to risk factors. Poor drainages and use of dumping sites for defecation might have contributed to this high prevalence. Generally there was improper management of toilet facilities in many schools and some did not even have one.

Prevalence of specific intestinal helminths infection among primary school pupils showed that out of 100 samples that were tested, 1561 different species of Helminth parasites were observed out of which four different intestinal helminth parasites were detected; the result shows that the highest Helminth parasite observed was *hookworm* 273(19.1%), followed by *Ascaris lumbricoides*, 23 (17.9%), *Trichuris trichiura* 15 (14.2%) and *Strongyloides stercoralis* 11(8.7%) respectively. The result clearly shows a statistical difference between parasites found and intestinal helminth infections (P<0.05) (Table 1). High prevalence of hookworm observed in this work could be as a result of the fact that majority of the infected pupils engage in agricultural activities working bare-footed in farm since 26(26.0%) of their Parents/Guardians were found to be Farmers. The species of parasites observed in this work is similar to the species of Helminth parasite observed in the work done on “the prevalence and Socio-Economic factors of intestinal Helminth infections among primary school pupils in Ozubulu, Anambra State, Nigeria” which reveals that 125 (48.08%) were positive for various intestinal helminthes with hookworm accounting for 66 (25.38%), *Ascaris lumbricoides* 40 (15.38%) *Trichuris trichura* 15 (5.77%), and mixed infections of *Ascaris* and hookworm 4 (1.54%) (Ezeagwuna *et al.*, 2019).

The above result shows the age specific prevalence of intestinal helminths infection among primary school pupils in Bokkos Local Government Area of Plateau State. The result revealed that out of the 76(76.0%) infected pupils age groups 3-5, 6-18, 9-12 and 13-above, 28(28.0%), 19(19.0%), 16(16.0%) and 13(13.0%) were recorded respectively. Age group 3-5yrs had the highest rate of infection while age 13-above has the least rate of infection. However, there was a statistical difference between age of pupil and intestinal helminth infections (P<0.05) (Table 2). The pupils between age group of 3-5 years were observed to have the highest rate of infection. Those pupils in age group of 13-above years had least prevalence. This may be due to their level of exposure to the risk factors. There is association between the age and the disease. Children of age group 3-6 years are more engaged in playing in contaminated environment due to regular playing objects. They are known for maintaining poor personal hygiene as this plays a role in intestinal parasitic infections. As the children grow there is better awareness in hand washing and other personal hygiene measures which reduce the chances of the children from getting infected. Result of this study is in contrast with that of Ezeagwuna *et al.*, (2019) who noted a high infection rate among age grade 11-13 years age group recording the highest infection rate of 77(85.77%) in Ozubulu, Anambra State Nigeria.

The result in table 3 above shows the prevalence of parasites in relation to gender (sex) in Bokkos Local Government Area of Plateau State, it reveals that out of 76.0% infected pupils, 34.0% were males, while 42.0% of female. This indicates that female children had the highest prevalence of intestinal helminths infection compared to male children in Bokkos L.G.A. However, there was a statistical difference between sex of pupil and intestinal helminth infections (P<0.05) (Table3). Sex-related prevalence shows that female pupils were more infected compared to the males. The reason may be due to the fact that females are more engaged in extracurricular activities such as recreational activities and games. The lower prevalence in males may be due to cultural practices, which require males to be indoors most of the time while females take part in many outdoor activities. The result obtained in this study is in agreement with that of Ezeagwuna *et al., (*2019) which noted that Females had the highest prevalence rate of 76 (55.47%) compared to the males with the rate of 49 (39.84%) which was statistically significant (P<0.05) in a work conducted on the prevalence and Socio-Economic factors of intestinal Helminth infections among primary school pupils in Ozubulu, Anambra State, Nigeria" Researches have also been carried out that compared the infection rates between the males and females school children. It was reported that the females had the highest prevalence rate compared to the males (Oblukwu *et al*., 2018). In addition, high prevalence rate was recorded among those whose parents were farmers and traders than those whose parents were civil servants. They opined that the reason is because the children, mostly the female children assisted their parents in farm works and other home chores (Oblukwu *et al*., 2018).

Assessment of the Respondent's response on the occupation of the Pupil's Paraents/Guardians in Bokkos, L.G.A, Plateau State (representing the effects of socio-economic factors on the prevalence of intestinal Helminth infections among pupils) shows that out of 76(76.0%) infected pupils, 26(26.0%) of the Parents/Guardians were Farmers, 20(20.0%) of their parents were Traders, 8(8.0%) of the Parents/Guardians were Civil Servants while 22(22.0%) of the Parents/Guardians were Artisans. Pupils whose Parents/Guardians are Farmers were more infected 26(26.0%) followed by Pupils whose Parents/Guardians are Traders 20(20.0%), Civil Servants 8(8.0%) and Artisans 22(22.0%) respectively. However, There was no significant association between the occupation (socio-economic factor) of the parents and the prevalence of intestinal Helminth infections among Pupils in Bokkos L.G.A, Plateau State P<0.05) (Table 4). This result is comparable to that of Ezeagwuna *et al.*, (2019) who worked on "the prevalence and Socio-Economic factors of intestinal Helminth infections among primary school pupils in Ozubulu, Anambra State, Nigeria" and noted that the infection occurred most in pupils whose parents were farmers 73 (59.84%). This has shown an index of the prevailing unhygienic environment, poor personal hygiene and poverty so there is an urgent need for mass deworming in all the public primary schools examined (Ezeagwuna *et al.*, 2009). Several socio-economic factors influence the prevalence and intensity of intestinal helminth infections. Economic status directly impacts the ability to afford safe housing, proper sanitation, and healthcare. Families with lower income levels are often unable to provide the resources needed to prevent and treat helminth infections effectively. Poor nutrition weakens the immune system, making children more susceptible to infections. Helminth infections, in turn, exacerbate nutritional deficiencies by impairing nutrient absorption. In rural settings like Bokkos LGA, children often engage in agricultural activities, which increase their exposure to contaminated soil and water, facilitating helminth transmission (Gyang, 2017). Socio-economic factors also play a major role in the transmission of intestinal helminths. As noted by Hall (2018), poverty is a significant determinant in the prevalence of helminth infections, particularly in developing countries. In economically disadvantaged areas, families may not have the resources to maintain good hygiene, provide safe drinking water, or access healthcare services. The inability to afford health treatments or preventive measures, such as deworming medications, further exacerbates the situation. Additionally, lower levels of education and limited awareness about the risks of helminths contribute to poor health-seeking behaviors and inadequate prevention strategies. Households in low-income communities are more likely to rely on contaminated water sources and live in environments conducive to the spread of parasitic infections. According to Moshi, (2023), poverty also restricts access to deworming medications and education on hygiene practices, exacerbating the cycle of infection.

In assessing the Respondent's response on the risk factors of intestinal heminth infection among pupils. It was observed to be a significant difference ($\chi^2 = 0.109$, df = 2, P = 0.021) (See Table 5). Out of 100 respondents, 54(54.0%) had a yes answer while 46(46.0%) had a No answer to the risk factors of intestinal helminth infection, 4(4.0%) of the pupils use borehole as a source of drinking water while 6(6.0%) use well water. 5(5.0%) of the Pupils use pit latrine while 4(4.0%) defecate openly in bushes and farms, 5(5.0%) do not wash hands before eating, 3(3.0%) and do not wash fruits and vegetables before consumption. Primary school pupils in Bokkos LGA are particularly at risk due to their regular activities that involve contact with soil and water, often in unsanitary conditions. The combination of environmental exposure and socio-economic challenges makes this population a key focus for understanding the dynamics of helminth infections in the region (Oyesola *et al.,* 2022). Several risk factor influences the prevalence of intestinal helminth infections amongst pupils in Bokkos L.G.A, Such as; inadequate sanitation facilities and poor hygiene practices, open defecation, lack of access to clean water, and improper disposal of human waste, low levels of education, particularly among parents and caregivers, are associated with higher infection rates. Education influences knowledge and practices related to hygiene and health, which are critical in preventing helminth infections. The pupils that used streams as sources of water supply 6(60.0%) had higher prevalence compared to those that use borehole and pipe-borne-water. There was significant association between the infection and use of well as sources of drinking water. This might be because heavy flood carries parasites and other contaminants into uncovered wells especially during rainy season in local communities. A situation that could lead to contamination and subsequent infection of exposed individuals. However, during the process of fetching water, the water containers or handle of the borehole engine and tap may be contaminated (Akinseye and Gbenga, 2019). In this study, 6(50.0%) of the pupils do not wash their hands after visiting the toilet and before eating, hence there is a possibility of fecal-oral transmission of intestinal helminth infection. It has been reported that the hands readily become contaminated after defecation even with the use of tissue paper. The human hands act as a common denominator in the transmission of intestinal parasites regardless of route of transmission (Oyibo and Amuga, 2016). Hands can act as conduits to transfer parasites from surfaces in or outside the home, currency, food and animals (pets or wild). The pupils that use pit latrine had higher prevalence 5(55.5%) while open defecation had a rate of 4(4.0%) and chi-sqaure values showed association between the disease and the toilet system. Similar observations were made among those that use pit latrine by Eneanya and Njom (2020). This could be due to poor sanitation which might encourage flies and cockroaches to spread cysts and eggs of intestinal parasites (Akinseye and Gbenga, 2019). The pupils that indicated not taking de-worming tablets were not infected than those that took it and those that took dewormers yearly were more infected compared to those that took within 6 months intervals. Positive cases recorded in those that were de-wormed may be due to re-infection after treatment. Gyang (2017) made such observations in Kufwan village in Plateau State, Nigeria. Chemotherapy is the best way of reducing the worm burden but there was a conflict of results in Northern Bangladesh where chemotherapeutic intervention was found not to have significant long-term impact. Improved living standards, environmental sanitation, agricultural and industrial hygiene can contribute to the success of the use of chemotherapy (Akinseye and Gbenga, 2019).

Educating children and families about the importance of washing fruits and vegetables, and properly cooking food can reduce the risk of ingesting helminth eggs (Okolo and John, 2019).

FUNDING

This work was funded by TETFUND Institutional Based Research, 2024

Declaration of Competing Interest

The authors would like to state that there was no conflict of interest resulting from funding or otherwise.

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