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Prevalence and associated risk factors of gastrointestinal parasitic infection among primary school children in Kazaure Local Government Area, Jigawa State, Nigeria

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Abstract

Intestinal parasitic infection in school-aged children is a major public health concern in developing countries, especially those in rural areas. The study determined the prevalence and risk factors of gastrointestinal parasitic infections among primary school children in Kazaure, Jigawa State. The study sampled a total of 501 pupils aged 6 to 14 years. Stool samples were collected and transported to the laboratory for analyses. The overall prevalence of gastrointestinal parasites among primary school children was 32.3% and most study participants were affected by single intestinal parasites predominantly ova of hookworm, followed by *Ascaris lumbricoides* and *Hymenolepis nana*, the most prevalent multiple parasites are *Ascaris lumbricoides* and hookworm. There was a significant relationship between gastrointestinal parasitic infections among primary school students of the Kazaure and the pupils age group, class, and water source ($p<0.05$). However, no significant relationship between gastrointestinal parasitic infections among the children and the gender, class, tribe and parents' income ($p>0.05$). Based on the findings of this study, it may be concluded that age, class, and water source are significant predictors of gastrointestinal parasitic infections among primary school children in the Kazaure. Public health measures should continue to emphasize the importance of environmental and personal hygiene.

Introduction

Intestinal Parasitic Infections (IPI) in children are highly prevalent in regions with limited or no access to safe drinking water, poor sanitation and substandard housing conditions (Benetton *et al* 2015). The main routes of entry of intestinal parasites into the human body are through ingestion, skin penetration, inhalation and auto-infection (Abate *et al* 2013). Soil-transmitted Helminth (STH) infections are among the most common diseases worldwide with an estimated 5 billion people at risk of STH (Mogaji *et al* 2022). Approximately 1.5 billion or 24% of the world's population are infected with STH with more than 260 million preschool-age children, 654 million school-age children, and 108 million adolescent girls living in areas where these parasites are endemic (WHO 2023)

Parasites may cause malabsorption and chronic blood loss, with long-term effects on the physical and cognitive development of children, especially in disadvantaged populations. Malnutrition renders children more vulnerable to Gastro-intestinal Parasitic Infection (GIPI), which may in turn result in protein-energy malnutrition, iron-deficiency anaemia and subsequent deficits in both mental and physical growth (Benetton *et al* 2015).

Parasitic infections, caused by intestinal helminths and protozoan parasites, are among the most prevalent infections in humans in developing countries. Species of parasitic worms are transmitted by eggs in human faeces, which contaminate the soil and water in poor sanitation areas (WHO 2016). In many countries, endemic intestinal parasitic infections are closely related to economic and social developmental processes therefore, their control may be a socially and politically sensitive issue (Kabiru *et al* 2015).

A greater proportion of infections are associated with poor water, sanitation and hygiene (Kabiru *et al* 2015). In developing countries, intestinal parasitic infections are major health problems. Epidemiological surveys on intestinal parasitic infections are important because they reflect the sanitary conditions of the community and produce basic data for the control of parasitosis in the future (Kabiru *et al* 2015). The source of drinking water has a significant effect on intestinal parasitic infection (Blessman *et al* 2012). There have been several reports from various parts of Nigeria that recognize them as important health problems, especially among children (Adeyeba and Akinlabi 2012). The limited knowledge, studies and data on the prevalence of intestinal parasites in Jigawa State necessitated the present study of the risk factors that influence intestinal parasitic infections. The knowledge of these risk factors and control of intestinal parasites can be a solution in preventing the transmission of gastrointestinal parasites among primary school children.

Materials and methods

Study area

Kazaure is a Local Government Area in Jigawa State, North western Nigeria, mainly populated by Hausa-Fulani people who are majorly farmers and traders. It has both urban and rural settlements. It lies between latitude 12°39′ 6″N and longitude 8°24′ 48″ E with an annual average temperature of 28.3°C (82.9°F). It has an area of 1,780km² with a population of 161,494 at the 2006 census (NPC 2006).

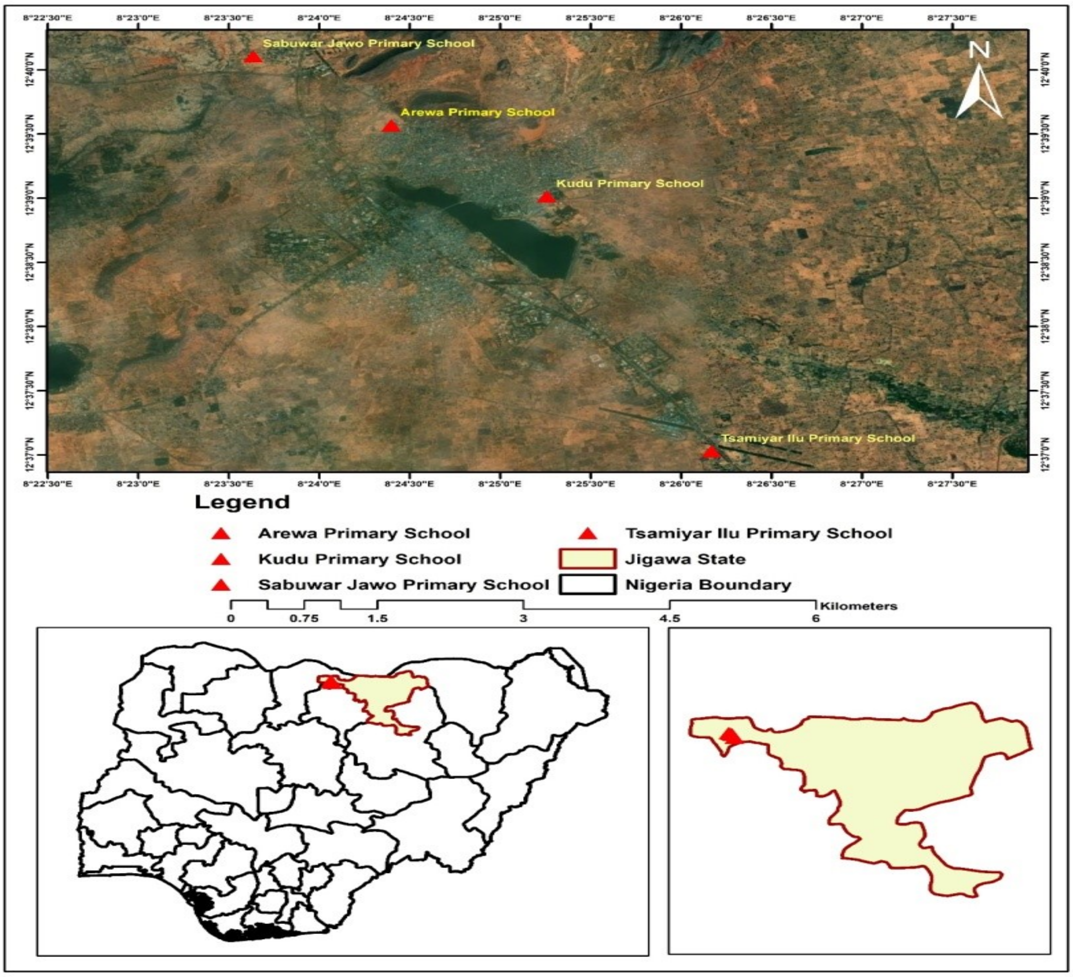

Figure 1. Map showing the geographical location of Kazaure and selected primary schools used for the study (map of Nigeria and Jigawa State inserted)
(Source: Geography Department, Federal University Dutsin Ma, Katsina State, Nigeria (FUDMA) Study design and population

This was a cross-sectional survey aimed at determining the prevalence and risk factors of GIPI among primary school children in the study area. Kazaure Local Government Area where this study was carried out had a total number of 53 primary schools with approximately 38,447 pupils, out of which, 69% (26,528 pupils) were aged 6-14years (SESP JIGAWA,2013-2022), and that was the projected population at the year of study. The selected primary schools studied were, Arewa Primary School, Jawo Sanda Primary School, Kudu Primary, and Tsamiyar Ilu Primary School.

Inclusion criteria

Pupils within the range of 6 to 14 years of age were included in the research. These represented ages most at risk of infection with intestinal parasites (Mamadou *et al* 2010). Also, pupils whose parents gave consent to participate in the study and those present during the survey were recruited to participate

Exclusion criteria

Pupils who did not fulfil the age range, those whose parents did not consent to the study and those who were absent during the survey were excluded.

Sample size determination

The sample size was calculated using the assumption of prevalence of 50% (prevalence = 50.0 % = 50.0/100 = 0.5). A standard epidemiological formula was used to calculate the sample size as follows;

$$\frac{Z^2 P\,(1-P)}{d^2}$$ (Cochran 1963)

Where;
n = Sample size,
z = standard normal distribution
95% confidence interval = 1.96
p = prevalence rate 50.0 % (0.50),
q = 1-p,
1 = is the maximum value of probability,

d = allowable error taken as 5% (0.05)

$$n = \frac{(1.96)^2 \times 0.50 \times (1-0.50)}{(0.05)^2} = 385$$

By adding an attrition rate of 30%, which is 30/100 x 385 = 115.5

Actual sample size= 385 + 116 = 501 children

Sampling techniques
A cluster random sampling was used to sample the schools. The schools were clustered into two zones (Kazaure South and Kazaure North) and then two schools were picked randomly from each zone. The selected schools were; Kudu Primary School, Tsamiyar Ilu Primary School, Arewa Primary School and Jawo Sanda Primary School. A total of 125 pupils each were selected randomly from three schools and 126 pupils were sampled from the remaining school to achieve the sample size of 501.

Sample collection
Clean, labelled wide-mouth faecal plastic specimen containers were given to the pupils and they were instructed on how to introduce stool samples into the containers. Applicator sticks and tissue papers were given to them as apparatus for collection. Two days were allocated to each school for the sample collection. Stool samples were collected and transported to the laboratory for parasitological analyses.

Physical examination of faeces
The collected stool specimens were first observed physically for consistency, presence of blood stains, mucous, and any macroscopic parasites (Cheesbrough, 2010).

Formol-ether concentration technique
The concentration technique was also employed in the analyses of the faecal samples.

Using an applicator stick, 1g (pea-size) of faeces was emulsified in about 4ml of 10% formol-saline contained in a screw-cap tube. A further 3ml of 10% v/v formol-saline was added and the bottle was capped, and mixed well by shaking. The emulsified faeces was sieved and the sieved suspension was collected in a beaker. The suspension was transferred to a centrifuge tube followed by the addition of 3-4ml of diethyl ether. The tube was stopped and mixed for 1 minute and with a tissue or piece of cloth wrapped around the top of the tube, the stopper was loosened and centrifuged immediately at 3000rpm for 1 minute. Using a stick, the layer of faecal debris was loosened from the side of the tube and the tube was inverted to discard the ether, faecal debris, and formal water. The sediment remained.

The tube was returned to its upright position and the fluid from the side of the tube was allowed to drain to the bottom. The bottom of the tube was tapped to re-suspend and mix the sediment. The sediment was then transferred to a slide, and covered with a cover glass. The preparation was examined microscopically using the 10× objective with the condenser iris to give a good contrast, 40× objective was used to examine small cysts and eggs (Cheesbrough 2010).

Administration of questionnaire
Questionnaires were used to obtain data on socio-demographic characteristics and risk factors. Socio-demographic characteristics included age and sex while risk factors included the source of drinking water, type of toilet used, personal hygiene, etc. The questionnaire was made valid by passing it through research experts. The questionnaire had three domains divided into:
Section A consisted of the socio-demographic data such as age, sex, gender, parent income, and Tribe
Section B consisted of the risk factors associated with intestinal parasitic infections such as source of drinking water, type of toilet used and Personal hygiene.
Section C consisted of laboratory diagnosis results

Data analyses
Data collected was analysed using the Statistical Package for Social Science (SPSS) Version 24.0. The chi-square test was used to determine the association between variables. Simple and multiple logistic regression analyses were used to determine the associated risk factors of the infections. Values were considered statistically significant at $p<0.05$

Ethical approval
Permission to conduct the research was obtained from the Ethics and Research Committee of the Ministry of Health, Jigawa State and the Local Education Authority of Kazaure Local Government Area. Participation of the pupils was voluntary. All respondents gave informed consent through their parents or legal guardians.

Results

Demographic characteristics of the participants
The socio-demographic distribution of the study participants is shown in Table 1. Five hundred and one (501) primary school students took part in the study, of which 60.9% were male and 39.1% were female. Hausa (54.49%) and Fulani (45.51%) were the predominant tribes in the study area, 46.3% of the participants were aged 6-8 years, 44.7% aged 9-11 years and 9.0% aged 12-14 years, 58.68% were from low-income families and 41.32% from medium income; 47.11% sourced their water from the borehole and 52.89% from the tap, 55.29% were in primary classes 1-2, 38.52% in primary classes 3-4 and 6.19% in primary classes 5-6.

Prevalence of gastrointestinal parasitic infections in the study population
From the examined population of 501 primary school children, 32.3% were found to be positive for gastrointestinal parasitic infections (Table 2). However, the odds ratio of 0.8 indicates a slightly lower likelihood of infection in males, although this difference was not statistically significant (p-value = 0.33). The age group 9-11 years exhibited the highest prevalence rate of 38.4%. The odds ratios (ORs), 1.6 for 9-11 years and 0.7 for 12-14 years indicate a higher risk of infection in the 9-11 years group and a slightly lower risk in the 12-14 years group compared to the reference group (6-8 years). The prevalence in the 6-8 years group was statistically significant (p=0.03), indicative of the vulnerability of

this younger age group to gastrointestinal parasitic infections.

The prevalence of gastrointestinal parasitic infections among primary school children was 24.0%, with an odds ratio of 0.6 (p=0.06). Kudu PS and Tsamiyar Ilu PS showed higher prevalence rates of 36.0% and 38.9%, respectively with ORs above 1 (1.2 and 0.6, respectively), a positive correlation between the schools and the prevalence of infections. Classes 5 and 6 stood out with a significantly higher prevalence rate of 51.6% and an OR of 2.4, indicating a correlation between higher classes and the prevalence of gastrointestinal parasitic infections (Table 2).

Infectivity status of gastrointestinal protozoans and geohelminthes according to sex and age group among primary school children in Kazaure

One hundred and forty-four (144) children (28.7%) exhibited infections caused by a single type of protozoan or geohelminth, 18 children (3.6%) were infected by multiple types of gastrointestinal protozoans or geohelminths (Table 3). Among the males, 212 children (69.3%) were free from infection, 82 children (26.8%) had single infections, and 12 children (3.9%) had multiple infections. Among the females, 127 children (65.1%) were not infected, 62 children (31.8%) had single infections, and 6 children (3.1%) had multiple infections. There was no statistically significant difference in infection rates among the different age groups and between male and female (p = 0.455).

Species-specific prevalence of gastrointestinal parasites according to sex and age group of primary school children in Kazaure

There is no significant difference in parasitic infection rates between males and females (p-value = 0.660) in the study population (Table 4). Age group 9-11 years had the highest prevalence of infection, with significant occurrences of *Ascaris lumbricoides* (AL) and Hookworm (HW) infections which were the most prevalent parasites across all categories. The co-infections (AL+HW, AL+HN, AL+EH) were relatively rare making singular parasitic infections more predominant than multiple infections. The age group of 9-11 years has a statistically significant p-value (≤ 0.05).

Multiple infection status of gastrointestinal parasitic infection among primary school children according to schools and classes in Kazaur

The data from Table 5 reveals that Jawo Sanda PS showed the lowest rate of multiple infections (4.8%), in contrast to Arewa PS which had a higher rate of both single and multiple infections (26.4% and 4.0% respectively). Tsamiyar Ilu PS had a moderate rate of multiple infections (5.6%). Classes 1 and 2 had a substantial prevalence of single infections and multiple infections (26.4% and 4.3% respectively), indicative of the susceptibility of younger children to gastrointestinal parasitic infections. Classes 3 and 4 exhibited a similar trend, although with slightly lower rates. Classes 5 and 6 had no case of multiple infections. The p-values for both schools (0.013) and classes (0.046) fell below this threshold, underscoring the significance of the disparities observed in infection statuses among the primary schools and classes in the study.

Parasitic fauna from infected children in the surveyed schools

The gastrointestinal parasites recovered from the faeces of infected children in the sampled schools include *Ascaris lumbricoides* (AL), Hookworm (HW), *Hymenolepis nana* (HN), and *Entamoeba histolytica* (EH) (Table 6). Jawo Sanda PS school had a relatively lower prevalence of parasitic infections with *Ascaris lumbricoides* (AL) being the most common. The coinfection of AL and HW was notable. Arewa PS had a higher prevalence of HW and HN. Tsamiyar Ilu PS School demonstrated a diverse range of infections, with HN and EH being prominent. Combined infections involving HN and AL, HN and EH, and AL and HW were observed among Classes 1, 2, 3, and 4 except 5 and 6. Classes 5 and 6 exhibited a lower overall prevalence of infections, however, HW and AL infections were observed.

Prevalence of gastro-intestinal parasitic infections according to socio-demographic data

Table 7 shows the prevalence of GIPI among the two major tribes (Fulani and Hausa) in Kazuare. Among the Fulani tribe, 34.6% tested positive for GIPI, whereas in the Hausa tribe, the prevalence was slightly lower (30.4%). The p-value of 0.312 indicates no significant difference in GIPI prevalence between the two tribes. Based on water sources (borehole and tap water), a higher prevalence of 37.7% was observed among individuals using borehole water, compared to 27.5% among those using tap water. The p-value of 0.015 indicates a statistically significant difference, indicating water source as a factor that influences the prevalence of GIPI. Socio-economic status (medium and low) was analyzed and a higher prevalence of 36.7% was found among individuals with medium parental income, compared to 29.3% among those with low parental income. However, the p-value of 0.079 suggests that this difference is not statistically significant.

Types of gastrointestinal parasitic infection according to tribe, water source, and parent's income among primary school children in Kazaure

The Fulani children showed a higher prevalence across most infection categories (single and multiple) compared to the Hausa children (Table 8). However, the differences are not statistically significant (p-value = 0.23). Based on water sources, children relying on tap water had slightly lower prevalence of infections in various categories compared to those dependent on borehole water, however, these differences are not statistically significant (p-value = 0.17).

Table 1: Demographic characteristics of the participants

Variables	Category	Frequency (n)	Percentage (%)
Sex	Male	305	60.9
	Female	196	39.1
Age-group (Years)	6 – 8	232	46.3
	9 - 11	224	44.7
	12-14	45	9.0
School	Jawo Sanda PS	125	24.95
	Arewa PS	125	24.95
	Kudu PS	125	24.95
	Tsamiyar Ilu PS	126	25.15
Class (Primary)	1 & 2	277	55.29
	3 & 4	193	38.52
	5 & 6	31	6.19
Tribe	Fulani	228	45.51
	Hausa	273	54.49
Water Source	Borehole	236	47.11
	Tap Water	265	52.89
Parents Income	Medium	207	41.32
	Low	294	58.68

Key: PS = Primary School

Table 2: Prevalence of parasitic infection in the study population

Variables	Category	Sample Size (n)	Number Negative	Number Positive	Prevalence (%)	OR	*p*-value
Overall		501	339	162	32.3		
Sex	Male	306	212	94	30.7	0.8	0.33
	Female	195	127	68	34.9	1.2	
Age (Years)	6-8	232	167	65	28.0	0.6	0.03
	9-11	224	138	86	38.4	1.6	
	12-14	45	34	11	24.4	0.7	
Schools	Jawo Sanda	125	95	30	24.0	0.6	0.06
(PS)	Arewa	125	87	38	30.4	0.9	
	Kudu	125	80	45	36.0	1.2	
	Tsamiyar Ilu	126	77	49	38.9	0.6	
Class	1 & 2	277	192	85	30.7	0.8	0.06
(Primary)	3 & 4	193	132	61	31.6	0.9	
	5 & 6	31	15	16	51.6	2.4	

Key: p value ≤ 0.05 is statistically considered significant. PS = Primary School

Table 3: Infectivity status in the study population

Variables	Category	No Infection (%)	Single Infection (%)	Multiple Infection (%)	*p*-value
Overall		339 (67.7)	144 (28.7)	18 (3.6)	
Sex	Male	212 (69.3)	82 (26.8)	12 (3.9)	0.46
	Female	127 (65.1)	62 (31.8)	6 (3.1)	
Age (Years)	6-8	167 (72.0)	57 (24.6)	8 (3.4)	0.09
	9-11	138 (61.6)	76 (33.9)	10 (4.5)	
	12-14	34 (75.6)	11 (24.4)	0 (0.0)	

Key: P value ≤ 0.05 is statistically considered significant

Discussion

Gastrointestinal parasitic infection is a major public health concern in developing countries that affects millions of school-aged children, especially those in rural areas. This is due to poor hygiene, lack of proper sanitation facilities, inadequate medical care, and difficulty in accessing proper health care services. The high prevalence of parasitic infections among children leads to chronic malnourishment, cognitive impairment, and poor academic performance. The gastrointestinal parasites found in this study were *Ascaris lumbricoides*, Hookworm, *Hymnolepis nana* and *Entamoeba histolytica*.

Table 4: Gastrointestinal parasites according to sex and age group among primary school children in Kazaure

V	Category	NP(%)	AL (%)	HW (%)	HN (%)	EH (%)	SM (%)	AL+HW (%)	AL+HN (%)	AL+EH (%)	*P*-value
Sex	Male	212 (69.3)	14 (4.6)	39 (12.7)	21 (6.9)	6 (2.0)	2 (0.7)	7 (2.3)	4 (1.3)	1 (0.3)	0.66
	Female	127 (65.1)	18 (9.2)	29 (14.9)	10 (2.0)	4 (2.1)	1 (0.5)	3 (1.5)	2 (1.0)	1 (0.5)	
Age (Y)	6-8	167 (72.0)	13 (5.6)	22 (9.5)	15 (6.5)	4 (1.7)	3 (1.3)	6 (2.6)	2 (0.9)	0 (0.0)	0.29
	9-11	138 (61.6)	16 (7.1)	41 (18.3)	14 (6.2)	5 (2.2)	0 (0.0)	4 (1.8)	4 (1.8)	2 (0.9)	
	12-14	34 (75.6)	3 (6.7)	5 (11.1)	2 (4.4)	1 (2.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

Key**:** NP = No parasite, V= Variables, AL = *Ascaris lumbricoides*, HW = Hookworm, HN = *Hymenolepis nana*, EH = *Entamoeba histolytica*. p value ≤ 0.05 is statistically considered significant

Table 5: Multiple infection status of gastrointestinal parasitic infection among primary school children according to schools and classes in Kazaure

Variable	Category	No Infection (%)	Single Infection (%)	Multiple Infection (%)	p-value
School	Jawo Sanda PS	95 (76.0)	24 (19.2)	6 (4.8)	0.013
	Arewa PS	87 (69.6)	33 (26.4)	5 (4.0)	
	Kudu PS	80 (64.0)	45 (36.0)	0 (0.0)	
	Tsamiyar Ilu PS	77 (61.1)	42 (33.3)	7 (5.6)	
Class (Primary)	1 & 2	192 (69.3)	73 (26.4)	12 (4.3)	0.046
	3 & 4	132 (68.4)	55 (28.5)	6 (3.1)	
	5 & 6	15 (48.4)	16 (51.6)	0 (0.0)	

Key: PS = Primary school, p value ≤ 0.05 is statistically considered significant

Table 6: Gastrointestinal parasites according to school and class among primary school children in Kazaure

V	Category	NP (%)	AL (%)	HW (%)	HN (%)	EH (%)	AL+HW (%)	AL+HN (%)	AL+EH (%)	p-value
School	Jawo Sanda PS	95 (76.0)	6 (4.8)	8 (6.4)	8 (6.4)	1 (0.8)	4 (3.2)	2 (1.6)	0 (0.0)	0.060
	Arewa PS	87 (69.6)	9 (7.2)	19 (15.2)	5 (4.0)	0 (0.0)	3 (2.4)	1 (0.8)	1 (0.8)	
	Kudu PS	80 (64.0)	10 (8.0)	23 (18.4)	5 (4.0)	5 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)	
	Tsamiyar Ilu PS	77 (61.1)	7 (5.6)	18 (14.3)	13 (10.3)	4 (3.2)	3 (2.4)	3 (2.4)	1 (0.8)	
Class (P)	1 & 2	192 (69.3)	19 (6.9)	30 (10.8)	16 (5.8)	5 (1.8)	7 (2.5)	4 (1.4)	1 (0.4)	0.325
	3 & 4	132 (68.4)	10 (5.2)	29 (15.0)	11 (5.7)	5 (2.6)	3 (1.6)	2 (1.0-)	1 (0.5)	
	5 & 6	15 (48.4)	3 (9.7)	9 (29.0)	4 (12.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

Key: V=Variables, P=Primary, NP = No parasite, AL = *Ascaris lumbricoides*, HW = Hook worm, HN = *Hymnolepis nana*, EH= *Entamoeba histolytica*

Table 7: Prevalence of gastro-intestinal parasitic infection according to tribe, water source and parents income

Variables	Category	Sample Size (n)	Number Negative	Number Positive	Prevalence (%)	p-value
Tribe	Fulani	228	149	79	34.6	0.312
	Hausa	273	190	83	30.4	
Water Source	Borehole	236	147	89	37.7	0.015
	Tap Water	265	192	73	27.5	
Parents Income	Medium	207	131	76	36.7	0.079
	Low	294	208	86	29.3	

Key**:** p value ≤ 0.05 is statistically considered significant

Table 8: Types of gastrointestinal parasitic infection according to tribe, water source and parents' income among primary school children in Kazaure

Variables	Category	NP (%)	AL (%)	HW (%)	HN (%)	EH (%)	SM (%)	AL+HW (%)	AL+HN (%)	AL+EH (%)	p-value
Tribe	Fulani	149 (65.4)	15 (6.6)	31 (13.6)	21 (9.2)	2 (0.9)	1 (0.4)	4 (1.8)	4 (1.8)	1 (0.4)	0.228
	Hausa	190 (69.6)	17 (6.2)	37 (13.6)	10 (3.7)	8 (2.9)	2 (0.7)	6 (2.2)	2 (0.7)	1 (0.4)	
Water Source	Borehole	147 (62.3)	14 (5.9)	39 (16.5)	19 (8.1)	6 (2.5)	1 (0.4)	4 (1.7)	5 (2.1)	1 (0.4)	0.166
	Tap Water	192 (72.5)	18 (6.8)	29 (10.9)	12 (4.5)	4 (1.5)	2 (0.8)	6 (2.3)	1 (0.4)	1 (0.4)	
Parents Income	Medium	131 (63.3)	14 (6.8)	32 (15.5)	13 (6.3)	5 (2.4)	2 (1.0)	7 (3.4)	1 (0.5)	2 (1.0)	0.210
	Low	208 (70.7)	18 (6.1)	36 (12.2)	18 (6.1)	5 (1.7)	1 (0.3)	3 (1.0)	5 (1.7)	0 (0.0)	

p-value ≤ 0.05 is statistically considered significant; NP = No of parasite, AL = *Ascaris lumbricoides*, HW = Hook worm, HN = *Hymnolepis nana*, EH= *Entamoeba histolytica,* SM= *Schistosoma mansoni*, AL+HW= *Ascaris lumbricoides* + Hook worm, AL+HN= *Ascaris lumbricoides + Hymnolepis nana,* AL+EH= *Ascaris lumbricoides + Entamoeba histolytica*

The co-infections (AL+HW, AL+HN, AL+EH) were sparse, indicating that singular parasitic infections were more common than multiple infections among the two major tribes (Fulani and Hausa) in Kauzare Local Government Area which is in tandem with Karshima *et al* (2018) who reported that the most prevalent parasites in school-aged children in Nigeria are hookworm, *Ascaris lumbricoides* and *Trichuris trichiura*, transmitted through faecal-oral route.

The prevalence of intestinal parasites observed from Kauzare Local Government Area was high (32.30%) in comparison with previous works by Oguoma *et al* (2008) in Imo State, where they reported a prevalence of 24.8%. Luka *et al* (2000) in Chikun, Kaduna South Local Government Area of Kaduna State, Nigeria, reported a lower prevalence (17.75%). Similarly, Orji *et al* (2015) reported an intestinal parasitic infection prevalence of 18.0% among inhabitants of the Uli community in Anambra State. A lower prevalence of 13.80% was reported by Okpala *et al* (2014) but in contrast, Udensi *et al* (2015) reported a higher prevalence of 47.70% which could be attributed to different geographical conditions. The Classes 1 and 2 children aged between 9-11 years had the highest prevalence of *Ascaris lumbricoides* in contrast to *E. histolytica* infection (6-8 years; 1.70%), (9-11 years; 2.20%) than older ones (12-14 years; 0.20%). This can be attributed to the fact that at 12-14 years of age young people become more hygiene-conscious compared to the lower age groups, hence are at lower risk of infection. This is consistent with the findings observed in Kaduna and Abia States of Nigeria (Luka *et al* 2000), indicating that younger children are more susceptible to these parasitic infections.

The intestinal parasites were more prevalent among the female students (34.90%) than the males (30.70%), this agrees with the report of Idowu and Rowland (2014) during an epidemiological study of gastrointestinal helminths among pupils in urban and suburban communities in Nigeria who reported that epidemiological studies have shown that prevalence of intestinal parasitic infections vary from one locality to other. The prevalence of intestinal parasitic infections in the four locations (Arewa PS, Tsamiyar ilu PS, Jawo Sanda PS, and Kudu PS) was not the same based on socio-economic status (Medium and low) and water source (tap and borehole) though this difference was insignificant (p>0.05). The minimal variation in prevalence could be due to similar environmental conditions. They share almost the same type of basic amenities, the same socio-economic status, and the same level of sanitation that predispose people to intestinal parasitic infections. This is in agreement with Tyoalumun *et al* (2016) who reported differences in prevalence in urban and rural communities but not rural to rural communities.

Timely interventions to reduce the prevalence of intestinal parasitic infections among school-aged children include mass deworming campaigns, the provision of clean water and sanitation facilities, and health education programmes. Mass deworming campaigns are effective in reducing the prevalence of parasitic infections, as shown in a study conducted in China, where the prevalence of *A. lumbricoides* and hookworm decreased from 53.50% and 62.90% to 6.70% and 1.70%, respectively, after a mass deworming campaign (Chen *et al* 2010).

Conclusion

Intestinal parasitic contamination remains a major public health challenge among school-aged children, especially in developing countries like Nigeria. The overall prevalence of gastrointestinal parasites among primary school children was 32.30% and most study participants were affected by single intestinal parasites predominately hookworm. Based on the findings of this study, it can be concluded that age, class, and water source are significant predictors of gastrointestinal parasitic infection among primary school children in the Kazaure Local Government Area of Jigawa State. Public health measures should continue to emphasize the importance of environmental and personal hygiene like avoiding open field defecation and discouraging consumption of raw/unwashed fruits, provisions of access to safe drinking water, sanitation facilities, healthcare services, deworming campaigns, and health education in rural areas to combat intestinal parasite infections.

Conflict of interest

The authors declare that there is no conflict of interest.

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