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Prevalence of Intestinal Parasitic Infections and Risk Factors among Primary School Children in Amai, Delta State, Nigeria

Paul Ikechuku Ogwezzy*, Jephtha Christopher Nmor and Andy Ogochukwu Egwunyenga.

Department of Animal and Environmental Biology, Faculty of Science, Delta State University, Abraka, Delta State, Nigeria.

*Corresponding author Email: ogwezzypaul@gmail.com, +234 (0) 806 342 6289

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ABSTRACT: The aim of this study was to examine the epidemiology of intestinal parasites and determine the risk factors linked to infection among primary school children in the Amai community. The research was conducted with 778 students from May to November 2017. Stool samples were obtained and tested for intestinal parasites using the direct smear (wet mount) technique, demographic and epidemiological information were obtained using well-structured questionnaires and the statistical analysis was carried out using Microsoft Excel and GraphPad Prism. The study showed that 338 (43.4%) were females while 440 (56.6%) were male with a total of 596 (76.6%) pupils found to harbour one or more intestinal parasitic infections. Eight species of intestinal parasites which include *Ascaris lumbricoides* (38.7%), *Entamoeba histolytica* (18.3%), *Entamoeba coli* (11.1%), *Giardia intestinalis* (8.7%), *Trichuris trichiura* (12.5%), *Endolimax nana* (4.9%), Hookworm (4.2%) and *Strongyloides stercoralis* (1.6%) were identified with single parasitic infection of 61.6%, double parasitisism of 34.6% and multiple parasitism of 2.9%. The prevalence of intestinal parasites differed significantly between boys (78.2%) and girls (74.6%) [P= 0.04885]. Pupils in age group 9-11 had the highest prevalent rate (45.2%) while age group ≥12 had the lowest prevalent rate (12.4%). Variables like parent occupation, distance to dumpsite, source of drinking water, type of toilet facility among others were found to be significant risk factors for intestinal parasitic infections. There was a significant prevalence of intestinal parasitic infections among children in the Amai community. Thus, improvement in sanitation, proper hygienic practices, and provision of potable water will help in reducing the transmission of intestinal parasitic infections in the study community.

Keywords: Prevalence, Significant, Technique, Parasitism.

Introduction

Intestinal parasitic infections (IPIs) are prevalent worldwide especially in tropical and sub-tropical regions and also in developing countries. Records have shown increasing trends in intestinal infections, particularly in developing nations (Gyang *et al*., 2019). They have been reported as the leading global cause of illness and disease (Quihui *et al*., 2006; Sehgal *et al*., 2010) and are considered a major public health issue worldwide. These infections are linked to factors such as poverty, inadequate access to safe drinking water, insufficient sanitation facilities, warm and humid tropical climates, poor hygiene practices, and limited healthcare services (Brooker *et al.*, 2006; WHO, 2010; 2012).

Intestinal parasitic infections are widespread globally, particularly in tropical and subtropical regions such as Nigeria (Mama and Alemu, 2015). Historical data suggest that approximately 4.5 billion people are at risk for intestinal nematode infections worldwide, with estimated case numbers including 807 million for *Ascaris lumbricoides*, 604 million for *Trichuris trichiura*, 576 million for hookworms (*Necator americanus* and *Ancylostoma duodenale*), 103 million for *Strongyloides stercoralis*, and 48 million for the protozoan *Entamoeba histolytica* (Bethony *et al.*, 2006; Hotez *et al*., 2008). Common parasites in this category include *Ascaris*

lumbricoides, *Trichuris trichiura*, *Enterobius vermicularis*, *Strongyloides stercoralis*, *Taenia* species, *Schistosoma mansoni*, *Entamoeba histolytica*, *Giardia lamblia*, and *Entamoeba coli*.
In Nigeria and other tropical countries, intestinal parasitic infections have been identified as a significant health concern at both national and state levels (Ivoke, 2007). Beyond their health implications, these infections are known to disrupt physical and cognitive development in children, impede educational progress, and obstruct economic growth (Mama and Alemu, 2015).

Materials and methods

Study area: Amai is a small rural area positioned in the hinterlands of the Niger Delta, part of the Ukwuani Local Government Area in Delta State, Southern Nigeria. The geographic coordinates of Amai are between 5.96° and 6.04° latitude and 6.48° and 6.59° longitude (Figure 1). The main economy of the people of Amai is mainly farming and petty trading. However, because of the presence of the Novena University, some business like business centres, ICT centres is now found in the community. The community is adequately equipped with key facilities, including electricity, boreholes, six government-funded primary schools, secondary schools, and a health centre. The climate in Amai is typically tropical. In most months of the year, there is significant rainfall in Amai and there is also a short dry season which is usually not very effective. Amai experiences an average annual rainfall of 2,301 mm, with an average yearly temperature of 26.7°C and a relative humidity of 85%. December is the driest month, receiving only 17 mm of rainfall, while the highest rainfall occurs in September, averaging 398 mm. March is the warmest month, with an average temperature of 28.3°C, whereas July has the lowest average temperature of 25.1°C. Amai community was chosen for this study because of the limited `updated data about the current situation on human.

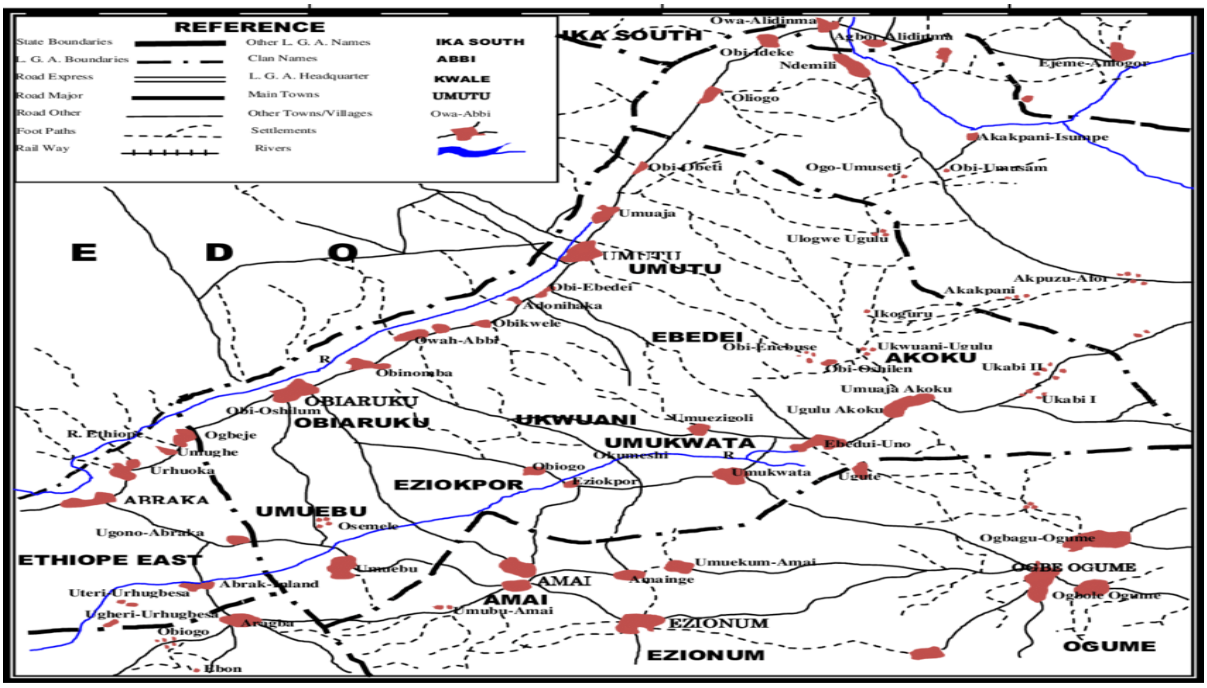

Figure 1: Map of Ukwuani showing Amai, the study area (*Source:* Ozulu *et al*., 2013).

Study design: The research was carried out from May to November 2017. The three primary schools examined were Nge, Igwete and Ekum primary school. Primary school children of different ages selected randomly from schools in Amai Community were involved in the study. Children were selected for this study because of their low immunity and the ease at which they come across the factors that are associated with these parasites. A total of 778 pupils (440 males and 338 females) that met the inclusion criteria (provided stool sample) participated in the study.
Consent and ethical consideration: Ethical clearance was obtained from the headmasters of all schools under study. The study subjects were informed about the objectives of the study and how the research was to be done. The participation in the study was completely voluntary and subjects were allowed to withdraw from the study at any point in the course of study if they wish to do so. Before the initiation of the study, meetings with the

school's headmasters were conducted, informing them of the objectives of the study and to ask for the permission to carry out the study.

Data and sample collection: In this study, demographic, socio-economic and sanitation variables among others were collected using well-structured questionnaires modified from Nmor *et al.* (2013). These questionnaires were filled by the pupils with assistance of their school teachers and the investigators. The questionnaires had three sections which collected information on Anthropometric variables like age, weight, sex, height; Household variables like distance of dumpsite, toilet facility; Hygienic/ Behavioural variables like source of drinking water, footwear use, washing of hands. After the questionnaires were completed, plastic labelled stool containers with covers and applicator sticks were distributed to the pupils and their identification number on the containers recorded. The ages of the children were noted, and their height and weight were measured according to WHO standards. Measurements were performed without footwear and in light clothing. Height was measured using a wall-mounted tape measure with a precision of 0.1 cm, and weight was measured with a calibrated scale that could weigh up to 150 kg, with a precision of 0.1 kg. The scale was placed on a hard flat surface during weighing.

Detailed instruction was given to the pupils on how to use the stool containers, hygienic handling of faecal samples and when to collect the stool. The fresh stool samples were collected the next day from the pupils and transported to the laboratory for parasitological examination.

Parasitological examination: After conducting a gross examination of the stool sample, a direct wet mount was created on a glass slide using an applicator stick or toothpick. A drop of saline was placed in the center of the left side of the slide, while a drop of Lugol's iodine was placed in the center of the right side. The stool sample was then mixed with the saline on one side and with the iodine on the other using the applicator stick or toothpick. Using a coverslip held at an angle, the slide was covered gently and examined microscopically at low and high magnifications in order to identify any mature parasite, cysts or eggs present.

Data analysis: All data from children questionnaires as well as the lugol's and saline test result were entered into Microsoft Office Excel spread sheet 2007 (Microsoft) following their respective codes and verified for accuracy. Data were cleaned by checking for errors, missing values and extreme values. All statistical analysis was carried out using graphpad prism statistical software. The Chi square test, t-test, ANOVA was used to determine bivariate and multivariate relationships between infection and risk factors. The level of significance was P<0.05.

Results

The characteristics and parasitological findings of the study are represented in Table 1. Overall, a total of 911 participants were present and responded to the questionnaire but only 778 gave stool samples indicating a response rate of 85.4%. Of the 778 subjects, 596 children were found to be infected with one or more intestinal parasites leading to an overall prevalence of 76.6%. As indicated, the mean age of the 778 children was 9.89± 1.8 for males and 9.53± 1.6 for the females; 24.2% were under the age of eight years and 58.4% were under the age 9-11. Male children comprised slightly over half (56.6%) of the study population. 30.4% had parents who earned their living from farming, 41.5% from other menial jobs, 11.3% are civil servants while 2.3% were unemployed (Table 1). Their mean ages, height and weight were all statistically different. However, their mean BMI showed no significant difference (Table 2).

Table 1: Socio-demographic characteristics of the study population

Variable	Category	n (%)
Age		
	6-8	188(24.2)
	9-11	454(58.4)
	≥12	136(19.5)
Sex		
	Male	440(56.6)
	Female	338(43.4)
Occupation		
	Unemployed	18(2.3)
	Farmer	240(30.4)
	Business	109(14)
	Civil servants	88(11.3)
	Others	323(41.5)

Table 2: General characteristics of the study population based on sex

Variables	Male (440)	Female (338)	P-value
Age	9.89±1.8	9.53±1.6	0.001
Mean Height (m)	1.27±8.1	1.30±7.7	<0.001
Mean Weight(kg)	25.28±4.8	26.36±5.1	0.003
Mean BMI	15.52±1.4	15.47±1.9	0.675

Parasitic profile of the studied children: Out of the 778 children examined, of which 440 were males and 338 were females, the prevalence rate of intestinal parasites was higher in males than females. Of the 440 males enrolled, 344 (78.2%) were infected while 252 (74.6%) females were infected with intestinal parasitic infections. There was significant difference in the sex prevalence of parasitic infection (P= 0.0485). The highest parasitic infection was *Ascaris lumbricoides* with the prevalence of 42.5% and 39.3 % in males and females respectively. The lowest infection was S*trongyloides stercoralis* 1.6% and 1.8% in males and females respectively. On specific examination of the different parasites, only *E. coli* showed a significant difference in distribution due to gender as represented in Table 3.

Table 3: The overall distribution of intestinal parasitic infection in children according to gender

Parameters	Number Infected (%)		P-value
	Male (440)	**Female (338)**	
Entamoeba coli	41(9.3)	51(15.1)	0.024
Endolimax nana	23(5.2)	18(5.3)	0.871
Giardia intestinalis	47(10.7)	25(7.4)	0.255
Trichuris trichiura	68(15.5)	36(10.7)	0.161
Hookworm	20(4.5)	15(4.4)	1.000
Ascaris lumbricoides	187(42.5)	133(39.3)	0.944
Strongyloides stercoralis	7(1.6)	6(1.8)	0.784
E. histolytica	75(17)	76(22.5)	0.081
Total	**344**	**252**	

As shown in Table 4 and Figure 2, children in age group 9-11 had the highest prevalence rate (56.8%) while those in age group 12 and above had the lowest prevalent rate (19.3%). Distribution of parasitic infection according to age showed a significant difference (P- value= 0.0473) but on further investigation on the different parasites, *Endolimax nana*, Hookworm, *Ascaris* and S*trongyloides* showed no significant difference. There were variations of intestinal parasitic infections with respect to age (Table 4). The prevalence of *Giardia lamblia* infection among the studied children between 6-8 years, 9-11 years, and ≥12 years were 15.4%, 8.2%, 4.4% respectively. The prevalence of *Entamoeba histolytica* was 7.4%, 19.2%, 36.8%. The prevalence of the non-pathogenic parasitic infection (*Entamoeba coli and Endolimax nana)* was higher in 6-8 age groups than in 9-11 and ≥12years. The prevalence of Hookworm among 6-8, 9-11 and ≥12 age groups were 2.35%, 1.00% and 1.31% respectively. The prevalence of *Ascaris lumbricoides* infection recorded among the ages 6-8, 9-11 and ≥12years are 39.9%, 45.2% and 30.9% respectively. *Strongyloides stercoralis* infection was recorded in ages 6-8, 9-11 and ≥12 years with prevalence of 1.1%, 1.8% and 2.2% respectively (Table 4).

Table 4: Prevalence of intestinal parasitic infections in different age groups

Parasitic infection		6-8	9-11	≥12	P-value
	N	188	454	136	
		n(%)	n(%)	n(%)	
E. coli		56(29.8)	18(4.0)	18(13.2)	<0.0001
E. nana		17(9.0)	24(5.3)	-	0.0027
G. intestinalis		29(15.4)	37(8.2)	6(4.4)	0.0051
T. trichiura		37(19.7)	39(8.6)	28(20.6)	0.0003
Hookworm		8(4.3)	24(5.3)	3(2.2)	0.3373
Ascaris lumbricoides		75(39.9)	205(45.2)	42(30.9)	0.1412
S. stercoralis		2(1.1)	8(1.8)	3(2.2)	0.7188
E. histolytica		14(7.4)	87(19.2)	50(36.8)	<0.0001

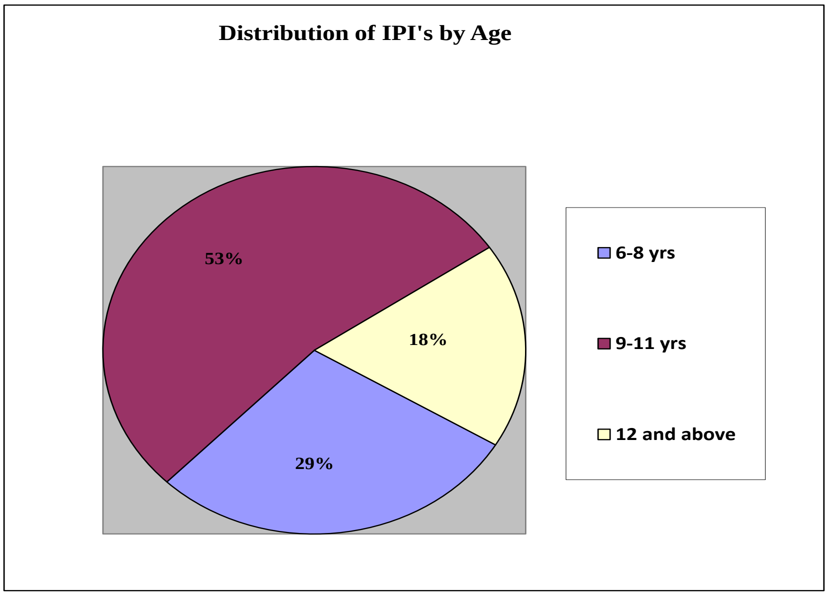

Figure 2: Distribution of intestinal parasitic diseases by age group

An overall prevalence of 76.6% was observed. Eight parasites were identified in the study population namely; *Ascaris lumbricoides* (38.7%), *Trichuris trichiura* (12.5%), Hookworm (4.2%), *Strongyloides Stercoralis* (1.6%), *Entamoeba histolytica* (18.3%), *Entamoeba coli* (11.1%), *Endolimax nana* (4.9%) and *Giardia intestinalis* (8.7%). Thus *Ascaris lumbricoides* was the most prevalent (Table 5).

Table 5: Prevalence of different parasitic infections

Parasitic infection	Number infected	Prevalence (%)
E. coli	92	11.1
Endolimax nana	41	4.9
G. intestinalis	72	8.7
T. trichiura	104	12.5
Hookworm	35	4.2
Ascaris lumbricoides	322	38.7
S. stercoralis	13	1.6
E. histolytica	152	18.3
Total	**831**	**100**

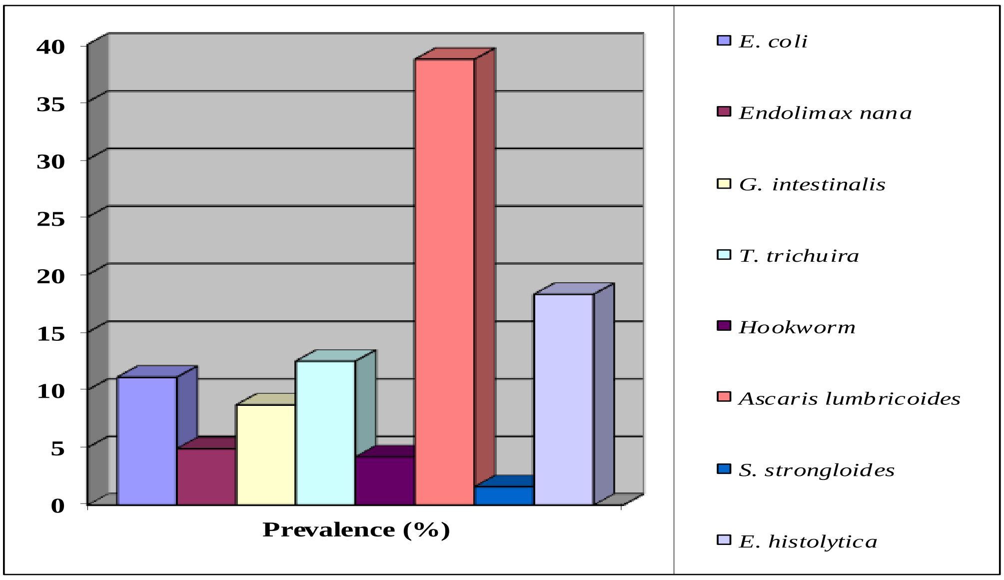

Figure 3: Prevalence of intestinal parasitic infections

Risk factors associated with intestinal parasitic infections: S. stercoralis was not significant with all the risk factors considered (P>0.05). Also *Ascaris lumbricoides* was not significant (P>0.05) with all the risk factors except presence of pets, fingernails and school uniform, in which it was found to be statistically significant (P<0.05). *E. coli* showed a statistically significant result to all the risk factors except washing of fruits, presence of pets and type of toilet (P<0.05). Age, occupation, distance of dumpsite, toilet facility, use of foot wears, washing of fruits before eating, condition of fingernails were all significant (P<0.05) to the transmission of *Endolimax nana.* While *Giardia intestinalis* showed no significant difference (P>0.05) to presence of pets, distance of dumpsite, type of toilet, use of foot wears, washing of fruits before eating, condition of fingernails and school uniform. Hookworm had risk factors like; use of foot wears, occupation, presence of pets, type of toilet, condition of fingernails and school uniform important for its transmission (P<0.05).Age, occupation, presence of pets, type of toilet, toilet facility, source of drinking water and washing of fruits before eating where important risk factors for Whipworm (P<0.05). finally, *E. histolytica* was statistically significant to condition of uniform, source of drinking water, use of foot wears, toilet facility, occupation, presence of pets, distance of dumpsite and age (P<0.05). Gender was not significant to all the parasites except *E. histolytica* and *E. coli.* Although age was not statistically significant with intestinal parasitic infections (P= 0.2243), but with gender and occupation there was a statistically significant difference in the prevalence of intestinal parasites (P= 0.0485, and P= 0.0217 respectively). Almost half of the study population had parents with other kinds of jobs like motorcycle riding, (41.5%) while 30.8% earned their living from farming.

Discussion

Intestinal parasitic infections, along with their morbidity, are considered the most widespread infections in developing nations, particularly affecting school-aged children (Nematian *et al*., 2008). This has led to considerable research efforts focused on these infections and their risk factors globally. Similarly, a comparative study was carried out to investigate intestinal parasitic infections and their associated risk factors among primary school children. The study observed an overall prevalence of intestinal parasitic infections of 76.6%, which is notably higher than the 51.54% prevalence documented by Asemota et al. (2012). Such differences might be related to geographic and socioeconomic variations between the study areas. *Entamoeba histolytica* was the most significant intestinal protozoan identified in this study, with an overall prevalence of 18.3% among the children. This prevalence differs from the 9.29% reported by Awolaju and Morenikeji (2008) in South West Nigeria and the 6.22% observed by Malla *et al*. (2004) in Nepal. The differences could be related to the efficacy of water supply and sanitation facilities, as well as geographical differences influencing parasite transmission. The investigation revealed a 57.0% prevalence of intestinal helminth infections, comprising Hookworm (4.2%), *Ascaris lumbricoides* (38.7%), *Trichuris trichiura* (12.5%), and *Strongyloides stercoralis* (1.6%). This prevalence rate is similar to the 53.6% observed by Chukwuma *et al*. (2009) in primary school children from Ebenebe Town, Anambra State, Nigeria, yet contrasts with the 80.0% prevalence reported by Nmor (2014) in a rural Delta State community along the Okumeshi River. The discrepancy may be due to heavy flooding, which could have introduced parasite eggs into the school and surrounding soil.

Also, most of the school children go to school barefooted leading to the high prevalence of *geohelminth infections* (Nmor *et al*., 2009). While the lower rate of prevalence in the present study could be because of the presence of moderate sewage and refuse dump facilities but the prevalence is still on the high side since 31.5% of the studied population lack sanitary facilities in their homes and defecate in the bush.

Ascaris lumbricoides was the most prevalent helminth recorded with a prevalence of 38.7%. This result was quite similar to another study that recorded a high prevalence of *Ascaris* in Delta state to be 42.78%; this may be due to the consistency of climate in Delta state being tropical, similarities in source of water supply for household purposes and the fact that the studied population habitually defecated in their surrounding environment. A study conducted by Arora (2005) revealed that sources of drinking water and their levels of cleanliness are a big factor in the infectivity of humans by parasites. *Strongyloides* infections (1.6%) were the lowest helminth observed. This corresponds to the study by Nmor *et al.* (2009) who stated that *Strongyloides* infection has never been common in Delta State.

Water polluted with human excreta will contain viable cysts and eggs of parasites which when swallowed by humans become infective for them. In the present study, intestinal parasitic infection was found to be significant (*p= 0.0422*) with the children's source of drinking but the studied children whose source of drinking water was borehole or well had the high infection compared to those who relied on pipe borne water. This could be attributed to low level of contamination of the water by the infective cyst of the parasites.

Also, Intestinal parasitic infections were statistically significant ($p < 0.05$) among children who lacked sanitary facilities, such as those using bushes or open fields. This finding aligns with WHO (1993), which highlighted that inadequate sanitation facilities are a major factor in the prevalence of intestinal parasitic infections. Additionally, Traub *et al*. (2005) noted that domestic animals, such as dogs and sheep, serve as reservoir hosts for certain intestinal parasites, contributing to higher infection rates. In the studied area, many households keep domestic animals like dogs, sheep, and goats, which are often allowed to roam freely. Intestinal parasitic infections were found to be statistically significant ($p < 0.05$) among children with inadequate hygiene practices in the study. Addy *et al*. (2004) demonstrated that the primary modes of transmission include the ingestion of contaminated food, water, and soil, as well as faeco-oral transmission.

Conclusion

In conclusion, this study has demonstrated a high rate of intestinal parasitic infections, with a prevalence of 76.6% among children in the Amai community. The predominant parasite identified was *Ascaris lumbricoides*, with a prevalence of 38.7%. Additionally, the study found the presence of *Entamoeba histolytica* (18.3%), *Entamoeba coli* (11.1%), *Giardia intestinalis* (8.7%), *Trichuris trichiura* (12.5%), *Endolimax nana* (4.9%), Hookworm (4.2%), and *Strongyloides stercoralis* (1.6%). The study found statistically significant differences ($p < 0.05$) in the rates of most pathogenic protozoan and helminth infections among the children in the study area. These differences were associated with risk factors such as inadequate environmental sanitation, the presence of pets, poor personal hygiene practices (including failure to wash hands before eating and after defecation), and parental occupation. Consequently, enhancing sanitation and ensuring a clean water supply are crucial for reducing the transmission of intestinal parasitic diseases in this community.

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