

School-Based Prevalence of Intestinal Parasitic Infections and Associated Risk Factors in Dosso Town, Niger Republic

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Submitted: 2025, Sep 01; Accepted: 2025, Oct 06; Published: 2025, Oct 13

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Citation: Aboubacar, O., Millogo, A., Traore, I., Bamba, S., Poda, A. G. E., et. al. (2025). School-Based Prevalence of Intestinal Parasitic Infections and Associated Risk Factors in Dosso Town, Niger Republic. *J Future Med Healthcare Innovation*, 3(2), 01-08.

Abstract

Introduction

Intestinal parasitic infections (IPIs) remain one of the major public health problems in developing countries. Assessing the prevalence of intestinal parasitic infections and associated factors in different localities is essential to improve control strategies.

Methods

We conducted a cross-sectional school-based study from November to December 2021. We selected study participants via a multi-stage cluster sampling technique. We used a structured questionnaire to collect data on sociodemographic variables and potential risk factors. From each pupil, we collected a fresh stool sample for fresh examination and concentration using two techniques (Willis and simplified Ritchie).

Results

We enrolled 370 pupils aged 7 to 16 in our study. Of these, 56 (15.1%) were infested with one or more parasites. Protozoa were more common (14.6%) than helminths (0.5%). The rate of bi-parasitism was 1.4%. The predominant parasites were *Entamoeba histolytica/Entamoeba dispar* (4.3%) followed by *Giardia lamblia* (3.8%). Bivariate analysis showed that only age was significantly associated with the occurrence of intestinal parasitic infections ($p < 0.05$).

Conclusion

These data show the persistence of protozoan infections as a major intestinal parasitic disease among schoolchildren in Niger. They also show the impact of improved living conditions and free government deworming programs on intestinal parasitic infections in school-age children in Niger.

Keywords: Intestinal Parasitic Infections, Schoolchildren, Dosso Town and Niger Republic

1. Introduction

Intestinal parasitic infections refer to a group of diseases caused by one or more species of protozoa, cestodes, trematodes and nematodes [1]. They remain a major public health problem, especially in poor and tropical regions [2,3]. Several infectious diseases caused by parasitic worms (schistosomiasis, tapeworms, trematodes infections and geohelminthiasis) have been classified as neglected tropical diseases (NTDs), as they persist mainly in socially and economically disadvantaged communities [1,2].

According to the World Health Organization (WHO), 3.5 billion people worldwide are exposed to intestinal parasitic infections and 450 million are ill [4]. It is estimated that over 270 million pre-school children and more than 600 million school-age children live in areas where transmission of these parasites is intense [1,3]. Intestinal parasitic infections are often associated with stunted growth, micronutrient deficiency leading to reduced resistance to infection, cognitive impairment, educational difficulties in children, and later, low social and economic productivity [5].

In Africa, regional distribution and differences in prevalence are mainly linked to lack of access to drinking water, poor sanitation and hygiene, socio-cultural, environmental and climatic factors [6,7]. Studies of school-age children show prevalence rates of 16.6% in Nigeria [8], 84.7% in Burkina Faso [2], 52.9% in Ethiopia [7] and 91.4% in the Democratic Republic of Congo [4].

In terms of control, a key strategy recommended by the WHO against these infections is the control of morbidity through mass treatment with preventive albendazole or mebendazole chemotherapy targeting high-risk groups such as preschool and school-age children, women of childbearing age, and since 2013, any high-risk adult [9].

In Niger, mass deworming programs focus on helminth control. The epidemiology of intestinal protozoa is not yet well described [10,11]. To our knowledge, the only published study of intestinal parasitic infections in schools was carried out in rural areas in 1986, and reported an overall prevalence of 57.5% [12].

In the Dosso town, the prevalence of childhood intestinal parasitic infections remains poorly understood. The aim of this study is to update knowledge on the prevalence of intestinal parasitic infections in schools, in order to provide decision-makers with reliable data for the development of control and prevention strategies.

2. Methods

2.1 Study Site

Dosso lies between longitude 3°20" and latitude 13°305", at an altitude of between 210 and 237 meters. It lies in the Sudano-Sahelian zone, with average rainfall ranging from 400 to 700 millimeters. Although there are no permanent watercourses, there are a few temporary pools used for market gardening and animal watering [13,14]. In 2021, the population of the municipality of Dosso was estimated at 124.093.

2.2 Design and Study Period

We conducted a descriptive and analytical cross-sectional study from November to December 2021 in primary schools in Dosso town to determine the prevalence of intestinal parasitic infections and associated factors.

2.3 Study Population

According to information from the Dosso Regional Directorate of National Education (2021), there were 20 primary schools. The study population consisted of pupils enrolled in primary schools in Dosso town. The study participants were pupils of both sexes, in "Year 3", "Year 4", "Year 5" and "Year 6" grade levels, whose parents had given their signed written consent and were able to provide a stool sample, and who had not taken any intestinal antiparasitic medication within 2 weeks. Pupils in "Year 1" and "Year 2" classes were not included because of their young age, making it difficult to interview them for data collection on associated factors.

2.4 Sample Size and Sampling Techniques

Based on the prevalence of 57.5% found in 1986 in rural Niger schools [12], the minimum sample size required was determined using the statistical formula for cross-sectional surveys: $n = [Z^2\alpha/2 \times P(1-P)] / d^2 = [1.962 \times 0.575 \times (1-0.575)] / 0.052 = 376$ pupils. To allow for any loss of data due to non-response, we increased the sample size by 24, giving a final size of 400 pupils.

Study participants were selected using multi-stage cluster sampling. Of the 20 elementary schools in the town, we selected five by a simple random draw, and we have chosen "Year 3", "Year 4", "Year 5" and "Year 6" grade levels on a purposive basis. Finally, for each grade, we recruited pupils with signed written parental consent who could provide a stool sample until we reached the required number.

2.5 Collection and Parasitological Examination of Stool Samples

We used a structured questionnaire to gather information on sociodemographic, health, hygiene, habitual and cultural factors, through an interview with each pupil. The day before the date agreed for stool sampling, we have given for each pupil a clean, dry, labelled plastic collection jar with instructions to deposit the stool in the morning. We transported the samples in coolers containing accumulators to keep them at +4°C until they arrived at the laboratory as quickly as possible.

Each stool sample underwent macroscopic examination, direct fresh microscopic examination, 2% lugol-stained microscopic examination and two concentration techniques (Willis and simplified Ritchie). In addition to these techniques, we performed a Graham anal scotch test on cases presenting with anal pruritus, in order to search for pinworm eggs or *Taenia saginata* embryophores.

2.6 Data Analysis

The data obtained were entered, processed and analyzed using IBM SPSS Statistics for Windows, version 25.0. We used the Pearson

Chi-square statistical test to study the association between the prevalence of intestinal parasitic infections as a dependent variable on the one hand, and sociodemographic characteristics, behavioral factors, individual hygiene practices and environmental sanitation factors as independent variables on the other. We considered results statistically significant when the p-value was less than 0.05.

2.7 Ethical Considerations

Letters have been sent to the administrative authorities of education (Regional Directorate of National Education) and health (Regional Directorates, Directorate of the Regional Hospital Center) to inform them of the research project on intestinal parasitosis in order to obtain their agreement. The regional authorities of the relevant services have given their authorization for the study to be carried out.

Before the start of data collection, we informed study participants of the purpose of the study, and we obtained agreement and written consent from the children's parents or guardians. We ensured confidentiality of all information.

3. Results

3.1 Socio-Demographic Characteristics

We selected 400 schoolchildren to take part in the study, and 370 (92.5%) completed questionnaires on associated factors and provided sufficient stool samples for parasitological examination. Of these, 199 (54%) were girls and 171 (46%) were boys. The pupils' ages ranged from 7 to 16 years, with an average age of 10.82 years. More than half (56%) were aged between 10 and 12 years.

The majority of pupils came from literate fathers (67%) and literate mothers (51%). Most pupils came from traders (35%), or civil servants (28%) fathers, and forty-six percent (46%) came from homemakers. All pupils reported having permanently available drinking water (tap, borehole) and latrines at home. Almost all pupils also reported washing their hands every time before meals (83%), and every time after bowel movements (88%). Two-thirds of pupils (67%) said they used the latrines at school when defecating (Table 1).

<i>Variables</i>	Category	Staff (n=370)	Percentage (%)
<i>Gender</i>	Male	171	46,20
	Female	199	53,80
<i>Age group</i>	7-9 years	94	25,40
	10-12 years	207	55,95
	13-16 years	69	18,65
<i>F a t h e r ' s profession</i>	Trader	129	34,90
	civil servant	103	27,80
	M a n u a l worker	50	13,50
	Other jobs	55	14,90
	Unemployed	33	8,90
<i>M o t h e r ' s profession</i>	Homemaker	168	45,40
	Merchant	116	31,40
	civil servant	67	18,10
	Other jobs	19	5,10
<i>Father's level of education</i>	Literate	248	67,00
	Uneducated	112	30,30
	ND*	10	2,70
<i>Mother's level of education</i>	Literate	189	51,10
	Uneducated	181	48,90
<i>Water supply</i>	Tap	366	98,90
	borehole	2	0,55
	Well	2	0,55
<i>Availability of latrines at home</i>	Yes	370	100,00
	No	0	0,00

Hand washing before the meal	Every time	308	83,20
	Often	62	16,80
Hand washing after bowel movements	Every time	327	88,40
	Often	43	11,60
Frequention of watercourses	Yes	31	8,40
	No	339	91,60
Wearing of shoes	Regular	249	67,30
	Irregular	121	32,70
Defecation practices at school	Latrines	248	67,00
	Out	33	8,90
	Nothing	89	24,10
A T C D deworming last 6 months	Yes	56	15,10
	No	314	84,90

Table 1 - Sociodemographic Characteristics of Schoolchildren in The Town of Dosso, Niger

3.2 Prevalence of Intestinal Parasitic Infections and Parasites Identified

Of the 370 pupils who took part in the study, 56 were infested with at least one parasite, giving an overall prevalence of 15.1%. The prevalence of protozoa and helminths was 14.6% and 0.5% respectively. We identified five parasite species. Of these, Entamoeba histolytica/Entamoeba dispar was predominant (4.3%),

followed by Giardia lamblia (3.8%), Endolimax nanus (2.4%), Entamoeba coli (2.7%) and Enterobius vermicularis (0.5%). We observed two types of parasitism. Among infested pupils, the majority were single-parasitized, with a prevalence of 13.8%. The prevalence of bi-parasitism was 1.4%. The parasitic associations found concerned protozoa (Table 2).

Parasitism/ Parasitic species	Parasitic forms			Total (n)	Prevalence (%)
	V. F/ Adult	Cysts/ Egg	Cyst + V. F		
Monoparasitism				51	13,8
Protozoa (total)				54	14,6
Entamoeba histolytica/ Entamoeba dispar	3	10	3	16	4,3
Giardia lamblia	0	14	0	14	3,8
Endolimax nanus	0	10	0	10	2,7
Entamoeba coli	0	9	0	9	2,4
Helminths (total)				2	0,5
Enterobius vermicularis	0	2	-	2	0,5
Bi-parasitism				5	1,4
E. histolytica/E. dispar +					

G. lamblia				3	0,8
E.coli + E.nanus				1	0,3
E. histolytica/E. dispar +					
E. nanus				1	0,3
Total infested				56	15,1

Table 2 - Different Species Identified in Stools and Type of Parasitism

3.3 Association Between Intestinal Parasitic Infections and Potential Factors

According to the bivariate analysis, boys were more parasitized (18.7%) than girls (12.1%). However, the difference was not statistically significant ($p > 0.05$). The prevalence of intestinal parasites was higher in the 10-12 age group (18.4%) than in other age groups. The variation in prevalence according to age in our study is statistically significant ($p = 0.04$). Age influenced parasitic

carriage.

Other potential risk factors, such as parents' level of education, parents' occupation, source of drinking water, hand washing, history of deworming and school defecation, were not associated with the occurrence of intestinal parasitic infections ($p > 0.05$) (Table 3)

Variables	Pupils examined	Parasitized pupils	Prevalence (%)	p-value
Gender				
Male	171	32	18,7	0,07
Female	199	24	12,1	
Age group				
7-9 years	94	7	7,4	0,04
10-12 years	207	38	18,4	
13-16 years	69	11	15,9	
Father's profession				
Trader	129	19	14,7	0,8
Civil servant	103	14	13,6	
Manual worker	50	8	16,0	
Other jobs	55	11	20,0	
Unemployed	33	4	12,1	
Mother's profession				
Homemaker	168	25	14,9	0,5
Merchant	116	21	18,1	
Civil servant	67	7	10,4	
Other Jobs	19	3	15,8	
Father's level of education				
Literate	248	40	16,1	0,6
Uneducated	112	14	12,5	
ND*	10	2	20,0	
Mother's level of education				
Literate	189	33	17,5	0,4
Uneducated	181	23	12,7	
Water supply				
Tap	366	55	15,0	0,3

borehole				
Well	2			
2	1			
0	50,0			
0,0				
Hand washing before the meal				
Every time	308	48	15,6	0,5
Often	62	8	12,9	
Hand washing after bowel movements				
Every time	327	51	15,6	0,4
Often	43	5	11,6	
Practices of defecation at school				
Latrines	248	37	14,9	0,8
Out	33	4	12,1	
Nothing	89	15	16,9	
ATCD deworming last 6 months				
Yes	56	8	14,3	0,8
No	314	48	15,3	

Table 3 - Association Between Intestinal Parasitic Infections and Various Factors

4. Discussion

The results show a prevalence of intestinal parasitic infections of 15.1% among schoolchildren in Dosso. This is close to the prevalence reported in Nigeria (16.6%) [8] and Kenya (17.3%) [15]. On the other hand, this rate is well below the prevalence (57.5%) reported in 1986 in a study carried out in the same country in a rural school environment [12]. The low prevalence reported in our study can be explained by the improvement in living conditions (boreholes, drinking water supply, construction of latrines) and the government's efforts to combat the disease through deworming campaigns and improved personal hygiene in most schools in urban areas (construction of classrooms equipped with latrines, supply of drinking water). Systematic deworming is also common practice in the pediatric wards of health centers. Even higher prevalence has been reported in urban school settings in Ethiopia (81%) [16] and in Sao Tome and Principe (64.7%) [17].

In our study, intestinal parasitism was mainly due to protozoa, with a prevalence of 14.6%, compared with 0.5% for helminths. This observation is in line with that of several authors [2,5,15]. Analysis of bibliographic data shows a predominance of intestinal protozoa in most developing countries [15,18–22]. These parasites are transmitted in cystic form essentially via poorly washed raw foods (fruit, vegetables, salads, etc.) and drinking water, most often from rivers polluted by human excreta and consumed without prior treatment [23]. On the other hand, other studies have reported a large predominance of helminths in Ethiopia [24] and in the DRC [4].

The two predominant species of pathogenic intestinal protozoa

observed were *Entamoeba histolytica*/*Entamoeba dispar* (4.3%) with a predominance of cystic forms, and *Giardia intestinalis* (3.8%) found only in the cystic form. This observation is in line with those of several authors [2,12,25]. The only helminth observed was *Enterobius vermicularis* (0.5%) in egg form. A similar finding was made in Morocco [26,27]. The low prevalence of helminths in our study may be linked to the success of national mass drug distribution programs against geohelminthiasis and schistosomiasis in schools. We observed two parasitism modalities, with a prevalence of 13.8% and 1.4% respectively for monoparasitism and biparasitism. The same observation was made in Ethiopia [7]. The parasitic associations found concerned only protozoa. This may be justified by the low frequency of helminths in our study.

The results of our study showed a difference between infestation rates for different age groups. The highest prevalence rate was recorded in the 10-12 age group (18.4%). This result is in agreement with that of Alwabr et al. in Yemen [28] and that of Gelaw et al in Ethiopia [29]. The high prevalence in older children may be due to their outdoor activities and behavior, which are conducive to parasitic infestation. As children get older, their exposure to the various risk factors for parasitic infestation increases. In contrast, other studies have shown a higher prevalence in younger children [21,25]. This difference in prevalence by age group in our study proved to be statistically significant ($p = 0.04$). A significant variation in prevalence according to age has been reported in several studies [24,25,30].

The present study also assessed the possible association of intestinal parasitic infections with potential risk factors in schoolchildren. The occurrence of intestinal parasitic infections was found not to be associated with most of the selected factors ($p > 0.05$). In contrast, several studies have identified a range of environmental, behavioral, and social risk factors associated with intestinal parasitic infections [1,7,24,25,31]. This could be explained by the fact that, on the one hand, our research area was urban, and on the other hand, certain socio-economic factors such as family income, type of housing and promiscuity were not explored.

Acknowledgements

The authors would like to acknowledge the regional education department, the regional public health department of Dosso, and the staff of the laboratory of the Dosso regional hospital center for their contributions to this work.

Funding

The authors declare that they have received no specific funding for this study".

Conflict of interest disclosure

The authors declare that they comply with the PCI rule of having no financial conflicts of interest in relation to the content of the article.

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