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Research Article

Prevalence and Associated Risk Factors of Hookworm Infection in Dutsin-Ma Town, Katsina State, Nigeria

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ABSTRACT

Hookworm infection remains a significant public health concern in many developing countries, particularly among school-aged children. This study determined the prevalence and associated risk factors of hookworm infection among school children in Dutsin-Ma Town, Katsina State, Nigeria. A total of 332 stool samples were collected from children attending both public and private schools. The samples were examined using the formalin-ether method followed by microscopic identification of hookworm ova. The overall prevalence of hookworm infection was 35.5% (118/332). Prevalence was higher in males (38.8%) compared to females (30.5%). Suggesting a possible gender-based variation. Similarly, prevalence appeared to increase with age, but these trends were not statistically significant (p= 0.976). Among the various factors assessed, handwashing before eating had a statistically significant preventive effect against hookworm infection (OR = 0.342, p = 0.030), indicating the relevance of hygiene practice. On the other hand, playing barefoot was associated with higher odds of infection (OR = 1.832, p = 0.080), although the result was not statistically significant. The findings indicate a moderate prevalence of hookworm infection among school-aged children in the study area, suggesting that age and hygiene-related behaviours may influence infection risk. This persistent public health concern underscores the need for integrated control strategies, including regular deworming, comprehensive health education, and improved hygiene and sanitation practices in schools, to reduce infection rates, safeguard child health, and prevent ongoing community transmission.

Keywords: Hygiene; Hookworm Infection; Prevalence; Risk factors; School children

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INTRODUCTION

Hookworm infection is among the most common neglected tropical diseases (NTDs), affecting millions of people worldwide, particularly in tropical and subtropical regions (Hotez *et al.,* 2014). It is caused by the nematodes *Ancylostoma duodenale* and *Necator americanus*, with infection occurring when infective larvae in contaminated soil penetrate the skin, usually through the feet, migrate to the lungs, and subsequently to the intestines, where they mature and produce eggs excreted in faeces, thus sustaining transmission in areas with poor sanitation and inadequate access to clean water (Loukas *et al.,* 2016; Hotez *et al.,* 2017). In Nigeria, hookworm remains a major public health concern, particularly among school-aged children who are more exposed due to behaviours such as playing barefoot in contaminated environments (Awotokun *et al.,* 2024). High infection rates have been reported across the country, with documented adverse effects on

children's physical growth and cognitive development (Afolabi and Ogunrinade, 2022). Dutsin-Ma, a town in Katsina State, faces similar challenges, with widespread soil-transmitted helminth infections attributed to poor sanitation facilities and open defaecation practices (Speich *et al.,* 2016; Manir *et al.,* 2017; Ismail *et al*., 2024). This study therefore aims to determine the prevalence and associated risk factors of hookworm infection among school-aged children in Dutsin-Ma, Katsina State, to inform the development of effective public health interventions (Addis *et al.,* 2014).

MATERIALS AND METHODS

Study Area

The study was conducted in Dutsin-Ma Town, in Dutsin-Ma Local Government Area of Katsina State, Nigeria. Dutsin-Ma lies in Zone A of the Katsina State geopolitical region at approximately latitude 12°27'6" N and longitude 7°29'53" E. The town has an estimated population of 169,671 people based on the 2006 national census. The inhabitants are predominantly Hausa and Fulani speakers, engaged mainly in farming, civil service, fishing, teaching, and small-scale trading. The climate is characterized by high temperatures averaging 35–39 °C annually. Vegetation is mainly composed of grasses, shrubs, and scattered trees. (Adejuwon, 2006; NPC, 2006;).

Study Population

The study population consisted of school children aged 5–13 years attending twelve selected public and private schools in Dutsin-Ma town. This age group was targeted because school children were at higher risk of hookworm infection due to increased exposure to contaminated soil and water (Bethony *et al*., 2006).

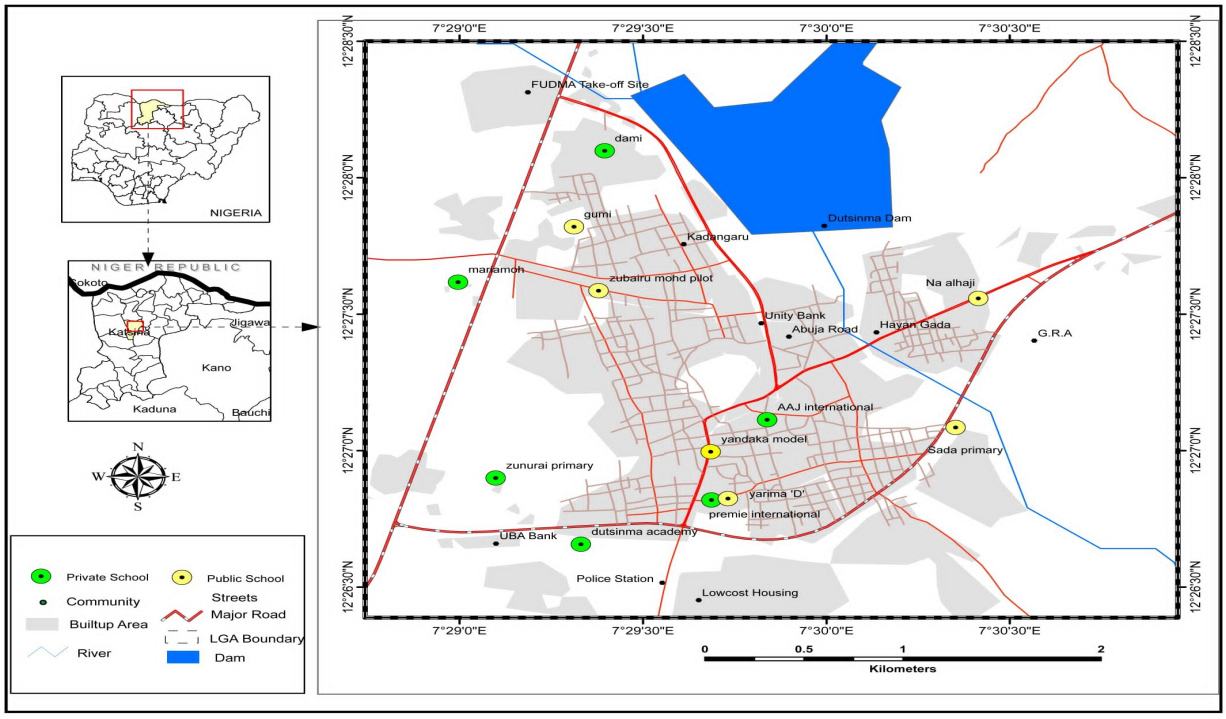

Fig 1. Map of the Study Area

Ethical consideration

Approval was obtained from the Katsina State Health Research Ethics Review Committee (MOH/ADM/SUB/1152/1/1087). Additional permission came from the State Universal Basic Education Authority and school headteachers. Parental consent and verbal child assent were obtained.

Sample Size Determination

The sample size was determined using the formula for estimating a population proportion: $N = \frac{Z^2 \times p \times (1-p)}{E^2}$ where:

N =Sample size

Z = Z-score corresponding to the desired level of confidence (1.96 for 95% confidence)
p = estimated prevalence of hookworm infection (Manir *et al*., 2017)
q= 1-p =
E = desired margin of error (0.05)
Based on this calculation, a total of 332 participants were enrolled in the study.

Sample Collection

A total of 332 stool samples were collected from children after obtaining parental consent and explaining the procedure to the participants. Each child was given a clean, labelled, wide-mouthed container and instructed to provide a fresh stool sample. Each child provided a fresh stool sample in a labelled container which was transported to Federal University Dutsin-Ma, New Biology Laboratory Complex for analysis. A structured questionnaire was also administered to the school children to collect information on demographic characteristics, hygiene practices, and other risk factors associated with hookworm infections.

Laboratory Analysis

Stool samples were preserved in 10% formalin immediately after collection to prevent degeneration of helminth eggs prior to laboratory analysis. Samples were processed using the formalin–ether concentration technique as described by (Gillespie and Pearson, 2001). Approximately 1 g of stool was emulsified in formalin, strained, and centrifuged at 1500 rpm for five minutes. The sediment was resuspended in ether, centrifuged, and the resulting deposit examined microscopically for hookworm ova. Egg identification followed the morphological criteria outlined in (WHO, 2019) and (CDC, 2024) guidelines, including an oval shape, a thin smooth shell, a clear perivitelline space, and dimensions of approximately 60–75 µm × 35–40 µm. Only eggs exhibiting intact morphology with characteristic internal segmentation were recorded as positive. Species differentiation between *Necator americanus* and *Ancylostoma duodenale* was not attempted owing to the similarity of their egg morphology. Each slide was examined independently by two trained microscopists, and any discrepancies were reviewed by a senior parasitologist. To assess inter-observer reliability, 10% of randomly selected slides were re-examined. Microscopes were calibrated prior to examination to ensure measurement accuracy, and all reagents were freshly prepared or verified for quality before use. All examinations adhered to standard parasitological quality assurance procedures to maintain diagnostic accuracy and reproducibility.

Data Analysis

Data collected were coded and entered into the Statistical Package for the Social Sciences (SPSS), version 26, for analysis. Descriptive statistics was used to determine the overall prevalence of hookworm infection. Associations between categorical variables was examined using the Pearson Chi-square test at a 95% confidence interval, with a p-value of less than 0.05 considered statistically significant. Variables that demonstrated significant associations in the bivariate analysis were subsequently included in a multivariate logistic regression model to identify independent predictors of hookworm infection.

RESULTS

Hookworm prevalence showed variation across the twelve schools; however, the differences were not statistically significant ($p > 0.05$) (Table 1).

Hookworm infection was generally more prevalent among males and in older age groups, although the differences across age and gender were not statistically significant ($p > 0.05$) (Table 2).

Among the risk factors assessed, handwashing before eating emerged as a significant protective factor against hookworm infection. Other factors, such as playing barefoot and toilet cleanliness, were not significantly associated with infection (Table 3).

Table 1. Prevalence of Hookworm Infection in the Selected Schools

NAME OF SCHOOLS	NO. EXAMINED	NO. POSITIVE	PREVALENCE (%)	P-VALUE
A.A.J International Academy	29	9	7.6	
Premier Primary School	29	12	10.2	
Dutsin-Ma Academy	25	10	8.5	
Zunurai Primary School	22	8	6.8	
M.A.M.I.S	30	9	7.6	

Dami Preparatory School	20	8	6.8	
Na-Alhaji Primary School	27	12	10.2	
Sada Primary School	30	15	12.7	
Zubairu Primary School	30	9	7.6	
Gumi Primary School	30	12	10.2	
Yarima Primary School	30	7	5.9	
Yandaka Primary School	30	7	5.9	
TOTAL	**332**	**118**	**35.5%**	**0.555**

Table 2. Prevalence of Hookworm Infection by Gender and Age Group

	MALE			**FEMALE**			**TOTAL**			**P-VALUE**
Age	No. Examined	Positive	%	No. Examined	Positive	%	No. Examined	Positive	%	
5-7	13	4	30.7	9	2	22.2	22	6	27.3	
8-10	86	26	30.2	57	18	31.5	143	44	30.7	
11-13	102	48	47.1	65	20	30.7	167	68	40.7	
Total	**201**	**78**	**38.8**	**131**	**40**	**30.5**	**332**	**118**	**35.5**	**0.976**

Table 3. Risk Factors Associated with Hookworm Infections among School Children in the Study Area

Variables		**Hook Worm**	**ODDs Ratio**	**p-value**	**95% C.I**
Hygiene and sanitation practices					
Hand wash after using the toilet	Yes	91	1.008	0.980	0.551-1.843
	No	241			
Hand wash before eating	Yes	88	0.342	0.030	0.130-0.904
	No	244			
Playing/walking bare foot	Yes	90	1.832	0.080	0.931-3.607
	No	242			
Environmental factors					
Access to tap water at home	Yes	50	1.412	0.210	0.823-2.422
	No	282			
Stagnant water around homes	Yes	21	0.846	0.610	0.445-1.608
	No	311			
Home surrounded by refuse dump or open defaecation site	Yes	17	0.652	0.206	0.336-1.265
	No	315			
Human faeces used for fertilizer in the farms near your homes	Yes	22	0.756	0.360	0.415-1.376
	No	310			
Toilet cleanliness at home and school	Yes	60	1.259	0.202	0.884-1.793
	No	272			
Sign/symptoms					
Stomach pain	Yes	84	1.201	0.510	0.697-2.067
	No	248			
Blood in stool	Yes	45	0.983	0.949	0.587-1.647
	No	287			
Diarrhoea	Yes	56	0.764	0.286	0.465-1.254
	No	276			
Bloated stomach	Yes	50	0.983	0.946	0.593-1.629
	No	282			

DISCUSSION

The moderate prevalence of hookworm infection observed in this study (35.5%) reflects a transitional epidemiological context, in which improving sanitation and hygiene coexist with persistent environmental exposure. Comparable studies in Nigeria report a wide range of prevalence, highlighting regional variation in exposure and

control measures. Prevalence in Ibadan and Oyo ranged from 34.2–35.8% (Adeyeba and Akinjogunla, 2005; Asaolu *et al.,* 2002), Benue State 35.4% (Ogbuagu and Okumah, 2013), and Delta State 38.1% (Umeh *et al.,* 2017), whereas lower rates were observed in Jos (5.1%) and parts of Benue (9.1%) (Bala and Yakubu, 2010; Yaji *et al.,* 2023). Higher prevalence was reported in Uyo (55.8%) and Ebonyi State (51.7%) (Ekpo *et al.,* 2010; Nwosu *et al.,* 2019), likely reflecting widespread open defecation, habitual barefoot walking, and limited deworming coverage. These variations indicate that the moderate prevalence in this study results from a balance between protective and risk factors operating within a heterogeneous environment. Handwashing before eating was identified as a significant preventive factor, confirming the central role of hygiene in reducing soil-transmitted helminth transmission (Freeman *et al.,* 2014; Strunz *et al.,* 2014). Conversely, walking barefoot increased the odds of infection, consistent with the established biological pathway of hookworm larvae penetrating the skin (Hotez *et al.,* 2014). The persistence of these behaviours demonstrates that, despite awareness and school-based interventions, preventive practices are not uniformly adopted, sustaining moderate prevalence. Age and gender patterns were consistent with previous observations, showing slightly higher prevalence among older male children, likely due to increased outdoor activity and soil contact (Brooker *et al.,* 2006). The lack of statistically significant differences across schools suggests relatively homogeneous environmental exposure, indicating that community-level factors, rather than school-specific conditions, drive transmission. Key limitations include the inability to differentiate between *Necator americanus* and *Ancylostoma duodenale*, restricting species-specific epidemiological insight. The cross-sectional design precludes causal inference and does not capture seasonal variation. Reliance on self-reported hygiene behaviours may introduce recall or social-desirability bias. Additionally, some risk behaviours, although present, may not have been consistently practiced to show statistical significance during data collection. Overall, the findings demonstrate a moderate burden of hookworm infection in the study area, maintained by a combination of behavioural, environmental, and demographic factors, despite partial adoption of preventative measures and ongoing interventions.

CONCLUSION

Hookworm infection remains a public health concern among school-aged children in Dutsin-Ma Town, driven by behavioural, environmental, and demographic factors. Promoting consistent hygiene, encouraging the use of footwear, and improving sanitation infrastructure are practical, actionable measures that can meaningfully reduce transmission and protect child health at the community level.

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Conflict of interest

The author declares that there is no conflict of interest

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