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***Research Article***

# Prevalence and Risk Factors of Intestinal Parasitic Infections among Schoolchildren in Katsina Metropolis, Katsina State, Nigeria

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**ABSTRACT**
Intestinal Parasitic Infections (IPIs) are significant causes of morbidity, particularly among school-aged children. This cross-sectional study was conducted to assess the prevalence and risk factors of intestinal parasitic infections among schoolchildren in Katsina Metropolis, Katsina State, Nigeria. A total of 420 schoolchildren from five randomly selected primary schools were enrolled for the study. Socio-demographic data were collected using structured questionnaires administered to both the children and their parents. Stool samples were analyzed using the Kato-Katz and direct wet-mount techniques to identify the presence of parasitic infections. The overall prevalence of intestinal parasitic infections was found to be 33.6%. The most prevalent parasite was Ascaris lumbricoides, detected in 28.0% of the children, and followed by Giardia lamblia (23.3%), Hookworm (22.8%), Entamoeba coli (19.5%), and Trichuris trichiura (6.6%). The prevalence was higher in males (37.1%) compared to females (30.1%). Children aged 6-9 years showed a significantly higher prevalence (38.0%) than those aged ≥10 years (30.0%) ($P<0.05$). The key risk factors identified included family size, dietary habits, lack of toilet facilities, drinking water sources and the educational status of parents. The study indicates that STHs and intestinal protozoa infections remain prevalent among schoolchildren in Katsina Metropolis, posing a substantial public health challenge. Addressing this issue requires increased public awareness, improved sanitation in schools, and the implementation of school-based deworming programs.

**Keywords:** Intestinal parasitic infections; Schoolchildren; Soil-transmitted helminths; Katsina Metropolis; Nigeria

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## INTRODUCTION

Intestinal Parasites, particularly Soil-transmitted helminths (STHs) are a category of intestinal worms that require a developmental period in the soil before they can become infectious to humans (Chukwuma *et al.,* 2009). These parasites, including *Ascaris lumbricoides*, *Trichuris trichiura*, hookworms, and *Strongyloides stercoralis*, are highly prevalent in regions with warm, moist climates which facilitate the maturation of their eggs and larvae (Cheesbrough, 2000; Ahmed and Sani, 2019). Research consistently shows that children, particularly those of school age, are among the most vulnerable groups to STH infections due to their frequent exposure to contaminated soil and inadequate sanitation (Grimes *et al.,* 2016; Parija *et al.,* 2017; Pabalan *et al.,* 2018; Fauziah *et al.,* 2022).

In Nigeria, a significant proportion of children are in preschool, primary, or secondary education, placing them at high risk of STH infections (Ahmed and Sani, 2019; Idowu *et al.,* 2022). It is estimated that globally over one billion people are infected with *A. lumbricoides*, approximately 800 million with hookworms, and around 770 million with *T. trichiura* (Grimes *et al.,* 2016). These infections are particularly common among children in tropical and subtropical regions, where they are a major cause of morbidity and mortality (Awolaju and Morenikeji, 2009). The transmission of STHs is closely linked to environmental

contamination with feces containing eggs of these parasites.

STHs are categorized as Neglected Tropical Diseases (NTDs) and are widespread in tropical and subtropical regions. They affect over 1.5 billion people in Africa, Asia, and Latin America according to the World Health Organization (2020). Among these, *Ascaris lumbricoides* is the most prevalent, infecting approximately 1.2 billion people worldwide, followed by *Trichuris trichiura* (around 795 million) and hookworms (*Ancylostoma duodenale* and *Necator americanus*), which collectively infect about 740 million individuals (WHO, 2006; Parija *et al.,* 2017). The high prevalence of STHs in these regions is often associated with low socioeconomic conditions and environmental factors that facilitate the spread of these infections (Brooker *et al.,* 2006).

According to WHO, an estimated 568 million school-aged children live in areas with ongoing transmission of STHs, putting them at a higher risk of infection (WHO, 2020). The increased susceptibility among children can be attributed to behaviors such as playing in contaminated soil, walking barefooted and poor personal hygiene practices. In developing countries, only about 53% of the population has access to improved sanitation facilities, which exacerbates the spread of these infections (Omarova *et al.,* 2018). STH infections can lead to chronic health issues, including anemia, malnutrition and cognitive impairments, which in turn affect school attendance, physical growth, and intellectual development (Pabalan *et al.,* 2016; Ahmed *et al*, 2012).

In Nigeria, STH infections represent a significant public health challenge, affecting more than 79 million people, including approximately 25 million school-aged children (Negussu *et al.,* 2017; Ahmed and Sani, 2019). Recent epidemiological studies have highlighted both the prevalence of these infections and the associated risk factors. A comprehensive analysis of these studies is needed to assess the national prevalence of STHs and identify high-risk regions that require targeted interventions. The WHO has set a goal to control STH infections by treating at least 75% of infected children in endemic areas by 2020 (WHO, 2020). In line with this, the Nigerian government initiated a national mass drug administration program in November 2015 to reduce STH-related morbidity (Ahmed and Sani, 2019). Effective implementation of these interventions requires a systematic review of existing data to identify priority areas and target populations.

In addition to STHs, pathogenic intestinal protozoa, such as *Entamoeba histolytica* and *Giardia intestinalis*, contribute to significant gastrointestinal morbidity, malnutrition and mortality, particularly among young children in developing countries (Fauziah *et al.,* 2022). *E. histolytica*, the causative agent of amoebiasis, is responsible for an estimated 40,000 to 100,000 deaths annually, making it one of the deadliest parasitic infections globally (Fauziah *et al.,* 2022). In China alone, *G. intestinalis* affects approximately 28.5 million people each year (Alamirew *et al.,* 2018). The prevalence of *G. intestinalis* varies significantly, with rates of 2-3% in developed countries and 20-30% in developing regions. Developing countries face significant challenges due to intestinal protozoan infections (Fauziah *et al.,* 2022). Among these, *Cryptosporidium* species are notable for causing diarrhea, particularly in immunocompromised individuals, such as those with HIV (Wang *et al.,* 2018). Another common anaerobic intestinal protozoan is *Blastocystis hominis*, whose role as a pathogen is still debated (Dubik *et al.,* 2022). The lack of access to clean water, sanitation, and hygiene significantly contributes to the spread of infections caused by intestinal protozoa (Sinclair *et al.,* 2016; Wang *et al.,* 2018).

This work tends to determine the current prevalence and determinants of soil-transmitted helminths (STHs) and pathogenic intestinal protozoa infections among school-aged children in Katsina Metropolis, Katsina State, Nigeria. By doing so, the study will contribute to the existing body of knowledge and inform targeted interventions for the prevention and control of intestinal parasitic infections among vulnerable children in this region.

## MATERIALS AND METHODS

### Study Area

Katsina State is located in Nigeria's North-West Geopolitical Zone, comprising 34 Local Government Areas with Katsina town as its capital and largest settlement. Spanning 24,192 square kilometers, the state is connected by a major highway linking Kano and Maradi in Niger Republic. Katsina town lies approximately on latitude 12° 15'N and longitude 7° 30'E, with a population of approximately 568,600 people dominated by Hausa and Fulani ethnic groups (NBS, 2022). The economy is primarily agrarian, focusing on peanuts (groundnut), millet, sorghum, and livestock farming. The climate is tropical wet and dry, with annual rainfall averaging 700mm, concentrated from May to September (Salihu, 2015).

### Consent and Ethical Considerations

Full ethical clearance with reference No.: MOH/ADM/SUB/1152/1/535 was acquired from the Katsina state Health Research Ethical Review committee (HREC) prior to commencement of the study, also permissions were obtained from the Education Secretary of Katsina Local Government Education Authority (LGEA), as well as from school heads, class teachers, and parents of the selected primary schools.

Detailed explanations about the study's objectives were provided and informed consent was obtained from both the participating pupils and their parents. Children who chose not to participate were allowed to opt out.

**Study Population**

Five primary schools in Katsina metropolis were randomly selected based on educational zones. In each selected school, fourteen students from each class (Primary 1 to Primary 6, comprising 7 males and 7 females) were randomly selected and included, totalling 84 students per school.

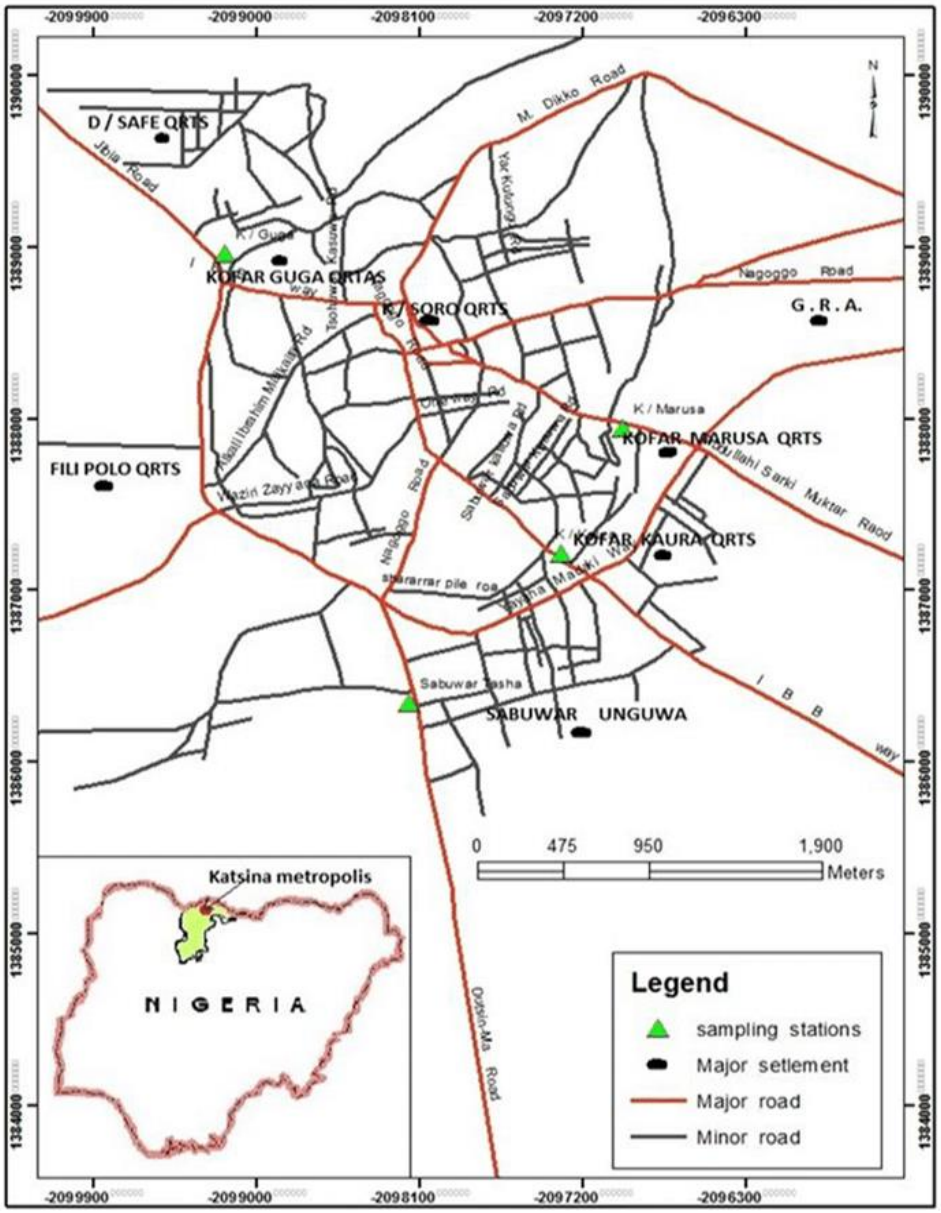


**Figure 1: Katsina metropolis map, outlining the study area**

**Sample Size Calculation**

The sample size of 420 children was determined based on the total enrolment of 17,470 pupils across the five selected primary schools, using the formula by Thrusfield (2005) and the Slovin's formula for sampling as described by Anugraheni *et al.,* (2023).

**Selection of Schools and Participants**

A random sampling method was employed to select schools, considering the educational zones under the LGEA. School selection involved writing school names on pieces of paper per zone and randomly picking one. Children were randomly selected using numbered papers, ensuring transparency in participant selection. Only the pupils who consented or agreed to participate in the study were put in the random selection process.

**Sample Collection**

Stool samples were collected from all selected pupils using clean, labelled plastic bottles. Detailed instructions were provided to parents and children on proper stool sample collection procedures to prevent contamination. Samples were collected between 10:00am and 1:00pm to ensure maximum pupil attendance/participation.

**Examination of Samples**

The stool samples collected were transported to the Department of Biology, Umaru Musa Yar'adua University, Katsina, for laboratory analysis. Parasitological examinations were conducted using Kato-Katz and Direct Wet Mount techniques. Kato-Katz technique was carried out as described by manufacturer's instructions; it involved smearing stool samples on slides, using a template to standardize the amount of sample, and staining with malachite green in glycerol. This method enables the detection and quantification of Helminth eggs under a microscope.

The Direct Wet Mount technique employed conventional iodine for staining and saline solution for easier observation of intestinal parasites' cysts, eggs, and trophozoites. This simple method aids in identifying motile parasites directly from the stool sample (Cheesbrough, 2000).

**Questionnaire Survey**

Structured pre-tested questionnaires were used to gather demographic and socio-economic data, including age, gender, family size and water source, presence of latrines, parental education level as well as footwear use among the participants.

**Data Analysis**

Data obtained from this research were analyzed using SPSS version 20.0 for Windows. Descriptive statistics were used to determine infection prevalence and chi-square test was used to assess associations between infection rates and socio-demographic factors.

## RESULTS AND DISCUSSION

**Prevalence of Infection**

The overall prevalence of infection by Intestinal parasites (STHs and Intestinal Protozoa) determined in this study was 33.6%. Five different parasites were isolated in the study namely; *Ascaris lumbricoides* (28.0%), *Giardia lamblia* (23.3%), Hookworms (22.8%), *Entamoeba coli* (19.5%) and *Trichuris trichiura* (6.6%). The detailed result is shown on Table 1. Higher prevalence of *A. lumbricoides* against other intestinal parasites has been recorded in previous studies in several previous studies (Yeshanew, *et al.,* 2022; Yahaya and Bishop, 2022; Iboh, *et al.,* 2020; Isma'il, 2016). The World Health Organization had also reported that *A.lumbricoides* is the most prevalent STH in the world (WHO, 2020). The higher prevalence of infection in the study area could generally be attributed to poor hygiene and ignorance among the children and their parents.

The results of our finding further showed that males have a higher prevalence of intestinal parasitic infections (37.1%) compared to females (30.1%). This finding aligns with previous studies that often report higher infection rates among boys than girls, possibly due to differences in behaviour, hygiene practices, or exposure to contaminated environments (Ahmed *et al.,* 2011, Parija *et al.,* 2017; WHO, 2020). Children aged 6-9 years exhibit a higher prevalence of infections (38.0%) compared to those aged 10 years and above (30.0%). This age-based difference in infection rates is consistent with the literature, which suggests that younger children are more vulnerable to soil-transmitted helminths (STHs) and intestinal protozoa due to their behaviors such as playing in contaminated areas and lower levels of personal hygiene (Brooker *et al.,* 2006; Awolaju and Morenikeji, 2009; Ahmed *et al.,* 2012). The higher prevalence of infections among males and younger children underscores the importance of targeted public health interventions (Table 2). Strategies such as school-based deworming programs and health education focusing on hygiene practices could help reduce infection rates among these vulnerable groups (Ahmed *et al.,* 2012; Negussu *et al.,* 2017).

**Table 1:** Identity and Prevalence of Intestinal Parasites isolated from the study population (n=420)

| Parasite Isolated | Prevalence (%) |
|---|---|
| *Ascaris lumbricoides* | 28.0 |
| *Giardia lamblia* | 23.3 |
| Hookworms | 22.8 |
| *Entamoeba coli* | 19.5 |
| *Trichuris trichiura* | 6.6 |
| **Total Prevalence** | **33.6** |

**Table 2:** Prevalence of intestinal Parasite infections in relation to gender and age (n=420)

| Variable | No. Examined | No. Infected | Prevalence |
|---|---|---|---|
| **Gender** | | | |
| Male | 210 | 78 | 37.1 |
| Female | 210 | 65 | 30.1 |
| **Age group** | | | |
| 6-9 years | 210 | 80 | 38.0 |
| ≥10 years | 210 | 63 | 30.0 |

**Prevalence of Infection in relation to Socio-demographic factors**

Children aged 6-9 years show a higher prevalence of infections (38.0%) compared to those aged ≥ 10 years (30.0%), although the difference is not statistically significant (P = 0.066). This aligns with some previous findings suggesting that younger children are more susceptible to infections by intestinal parasites due to behaviour and hygiene practices (Brooker *et al.,* 2006; Ahmed *et al.,* 2012; Idowu *et al.,* 2022).

In our findings, children from larger families (≥ 8 members) exhibit a significantly higher prevalence of infections (42.8%) compared to those from smaller families (2-7 members) (29.6%) (P<0.001). This association may be attributed to increased household density and sanitation challenges as earlier suggested by Awolaju and Morenikeji (2009). Accordingly, higher prevalence rates are observed among children whose fathers have no formal education (61.5%), those whose parents engaged in farming or other occupations (84.0%), and those whose mothers have no formal education (24.4%). Similarly, those children whose mothers are engaged in business (97.5%) were found to be more infected compared to their counterparts. This could be attributed to the fact that businesswomen in this area tend to dedicate most of their times daily on their business outfits, leaving their children with less care from their siblings and neighbours, who may in turn not offer the expected care. These findings underscore the influence of parental education and occupation on household hygiene and health practices (Ahmed *et al.,* 2011).

Lack of toilet facilities at home correlates with a higher prevalence of infections (72.8%) compared to households with toilet facilities (26.3%) (P<0.001). Similar associations are observed with infections among the children that participated in this research with the following; unhealthy source of water supply, eating food with fingers, as well as playing barefooted. This finding agrees with the results from some previous similar researches (Sinclair *et al.,* 2016; Omarova *et al.,* 2018). The detailed results are shown on Table 3. Targeted interventions and deliberate efforts focusing on improving sanitation, infrastructure, good hygienic practices and effective public enlightenment could effectively reduce infection rates in the study area.

**Table 3:** Risk factors associated with Intestinal Parasitic Infections in relation to some socio-demographic factors among the study population (n=420)

| VARIABLE | No. examined | No. infected (%) | P – Value |
|---|---|---|---|
| **Age group** | | | |
| 6-9 years | 210 | 80 (38.0) | 0.066 |
| ≥ 10 years | 210 | 63 (30.0) | |
| **Gender** | | | |
| Male | 210 | 78 (37.1) | 0.108 |
| Female | 210 | 65 (30.1) | |
| **Family Size** | | | |
| ≥ 8 members | 140 | 60 (42.8) | <0.001* |
| 2-7 Members | 280 | 83 (29.6) | |
| **Father`s education status** | | | |
| Educated | 290 | 63 (21.7) | |
| No-formal Education | 130 | 80 (61.5) | 0.050* |
| **Father`s occupation** | | | |
| Civil service | 105 | 41 (39.0) | |
| Business | 290 | 78 (26.8) | |
| Farming /others | 25 | 21 (84.0) | 0.000* |
| **Mother`s education status** | | | |
| No Formal education | 84 | 61 (72.6) | 0.000* |

| | | | |
|---|---|---|---|
| Educated | 336 | 82 (24.4) | |
| **Mother`s occupation** | | | |
| Housewife | 320 | 46 (14.4) | 0.000* |
| Business | 80 | 78 (97.5) | |
| Civil service | 20 | 19 (95) | |
| **Toilet facility at home** | | | |
| No | 70 | 51 (72.8) | 0.000* |
| Yes | 350 | 92 (26.3) | |
| **Defecation habit** | | | |
| Toilet | 420 | 143 (34.0) | |
| Open bush | 0 | 0 (0) | |
| **Main source of water** | | | |
| Well | 128 | 63 (49.2) | 0.000* |
| Borehole | 232 | 65 (28.0) | |
| Tap | 60 | 15 (25.0) | |
| Pond | 0 | 0 (0) | |
| **Eating habit** | | | |
| fingers/hand | 280 | 98 (35.0) | 0.000* |
| Spoon | 140 | 45 (32.1) | |
| **Playing bare footed** | | | |
| No | 288 | 85 (29.5) | 0.017* |
| Yes | 132 | 58 (43.9) | |

*Variables are significant at $P \leq 0.05$

## CONCLUSION

In conclusion, the findings from this research highlight the current prevalence of intestinal parasitic infections among schoolchildren in Katsina metropolis. The study further determined the major predictors of intestinal parasitic infections among the children in the study area. The need for integrated public health strategies are thus highlighted so as to pave way for addressing the menace of infections by intestinal parasites in Katsina metropolis and environs.

Based on these findings, it is recommended that; Health policies should consider gender-specific and age-specific approaches to combating intestinal parasitic infections; Efforts should be made to improve sanitation facilities, promote hand washing practices and provide regular deforming treatments in schools and communities; Support programs aimed at improving parental education and livelihoods could contribute to sustained reductions in parasitic infections among children in the area; Further studies are required to look deeper into the specific behavioural and environmental factors contributing to higher infection rates among children in Katsina State. Further studies should also target the impact of burden of infection on the educational outcomes of the children in the area. This would help refine intervention strategies and improve their effectiveness in reducing parasitic infections in similar settings.

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