

## Intestinal Parasitic Infections in Rural and Urban Areas of Niger State, Nigeria

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### Abstract

*Intestinal Parasite Infections (IPIs) are helminths and protozoa infections of serious public health concern, especially among children of developing world. The risk factors include poor access to clean water supply and good sanitation, poor hygiene practices, low level of public health education and fecal contamination. Stool samples collected from randomly selected population of children (4-15 years) and adults (25-50 years) in rural and urban regions of Kontagora LGA, were analyzed to determine the prevalence of IPIs. Descriptive statistics and inferential tests were employed at 0.05 significant level. Of the 104 children investigated, 67 (64.4%) in the rural and 49 (37.7%) in the urban areas were infected with at least a species of the intestinal parasites. Adults sampled in the rural area had prevalence rate of 59.2% while those in the urban area had 28.3% rate of infection. The mean parasite intensity in children within both regions was 2.93 in rural and 1.63 in urban areas. Of the sampled adults, 59.2% prevalence rate was recorded, with 85.1% infected with *Ascaris lumbricoides*, 62.1% with *Necator americanus*, 21.6% for *Trichuris trichiura*, 8.2% for *Strongyloides stercoralis* and 63.5% for *Entamoeba histolytica*. This study serves as reliable means for treatment decisions in Mass Drug Administration programmes and surveillance. Availability of clean water, improved environmental sanitation and personal hygiene practices, and sustainable public health education are important for long term preventive and control measures*

**Keywords:** IPIs, STH, Protozoa, Children, Adults, Regions

## Introduction

Soil transmitted Helminths (STHs) and Protozoa infections are major Intestinal Parasitic Infections (IPIs) of interest worldwide (CDC, 2022), with about one-quarter of the world's population affected with over 450 million cases of morbidity, majorly children and women of reproductive age due to their level of immunity (Ahmed, 2023). STHs affect about 1.5 billion people globally, mainly in tropical and Sub-tropical regions of the world (WHO, 2023), with about 5.9 billion at risk, with children been the most vulnerable of all groups. In Sub-Saharan Africa, South America, China and Asia, over 600 million children are estimated to be more susceptible due to higher possibility of playing with soil and their low immune system. However, studies show that residents of communities that lack access to clean water, proper environmental sanitation, hygiene practices and frequent contact to soil are at greater risk of infection

The most common species of intestinal parasites of Neglected Tropical Diseases (NTDs) which cause intestinal-related complications include *Ascaris lumbricoides* (round worm) which infects about 19 million people worldwide, *Necator americanus* and *Ancylostoma duodenale* (hookworm), *Trichuris trichiura* (whipworm) and *Strongyloides stercoralis* (Hotez *et al.*, 2015) while common protozoan parasites are *Entamoeba histolytica*, *Gardia intestinalis* and *Cryptosporidium spp*, which infect about 200-500 million respectively (Gyang *et al.*, 2019). These infections are influenced by environmental and socio-economic factors, geography, hygiene practices and level of public awareness.

In Nigeria, certain parts are endemic with these IPIs as a result of poor hygiene habits, resulting to contamination of food and water, inadequate basic amenities and good sanitary facilities (Amisu *et al.*, 2023). These infections are transmitted fecal-orally, through direct hand to mouth or through contaminated food, water or environment (soil). According to Norhayati *et al.*, (2002), prevalence of IPIs can be used as an indicator of the conditions of living, environmental sanitation and socio-economic status of a community, which is predominated by method of fecal disposal, cleanliness of the environment, water supply, personal hygiene and level of public health education.

People with light STH infections are asymptomatic, with low morbidity and mortality. IPIs cause iron deficiency anaemia, stunted growth and low cognitive development in children and other

physical and mental-related health problems (Ito & Egwunyega, 2017). Those with heavy infections suffer from intestinal disorders, reduction of nutritional intake resulting to malnutrition, weakness, impaired growth, physical and mental development. This also leads to loss of iron and protein as the parasites feed on host tissues. In female of various ages, chronic intestinal blood can result in anaemia and depletion of some essential nutrients in the body (Okeke et al., 2023). Thus, determining the prevalence, intensity and impacts of these infections on humans is of public health significance. This study was undertaken to investigate the prevalence of IPIs in different age groups and geography in Niger state, so as to improve control measures.

### **Methodology**

This is a cross-sectional study that investigates the prevalence of IPIs among children and adults from the rural and urban areas of Kontagora Local Government Area. The study was carried out in randomly selected villages with evident low standard of living, unavailability of basic amenities and poor environmental conditions, with population comprising children between 4-15 years, farmers and other artisans of 25-50 years. Participants were also sampled in the town of Kontagora as representatives of the urban settings of this study. A total of 234 children and 217 adults were sampled. Their demographic and Knowledge, Attitude and Practices (KAP) information were collected using a pre-tested semi-structured questionnaire.

Ethical approval for the study was obtained from the State General Hospital Management Board and informed consents of the subjects were sought. Data protection of subjects for confidentiality was upheld. Stool samples were collected in screw-capped bottles and analysis was done in the laboratory using formol-ether concentration technique and microscopy for egg/cyst identification and conventional Baermann technique was adopted for isolation of larvae.

**Formol-Ether (Formalin-Ether) Concentration Method:** 1g of sampled stool sample was added to a centrifuge tube of 7ml of 10% formol water. The suspension was filtered and 4ml diethyl ether was added. The supernatant after centrifugation was discarded and a smear of the sediment was prepared on a slide for microscopic observation (Agarwal *et al.*, 2025).

Baermann Technique: 3g of faeces in cheese cloth was tied to form a pouch, suspended in a funnel within the mouth of a centrifuge tube. Lukewarm distilled water was added to cover the top of the fecal pouch and left to stand for 24 hours. 2ml of the filtered sediment was collected and centrifuged. The supernatant was carefully removed with a pipette, leaving the sediment. The sediment was placed on a slide for microscopic observation for larvae (Tagesu, 2018).

Laboratory results were collected for the two age groups at both rural and urban areas of the Local Government area. Socio-demographic information and KAP of the study population was also collected. Statistical analysis was done using SPSS (version 21.0). Descriptive statistics and categorical variables were described in frequency and percentages. Inferential tests (independent sample T-test and Chi-square) were employed at a 0.05 significance level.

## **Result**

Of the 104 children investigated, 67 (64.4%) in the rural and 49 (37.7%) in the urban areas were infected with at least a species of the intestinal parasites. Adults sampled in the rural area had prevalence rate of 59.2% while those in the urban area had 28.3% rate of infection (Fig. 1).

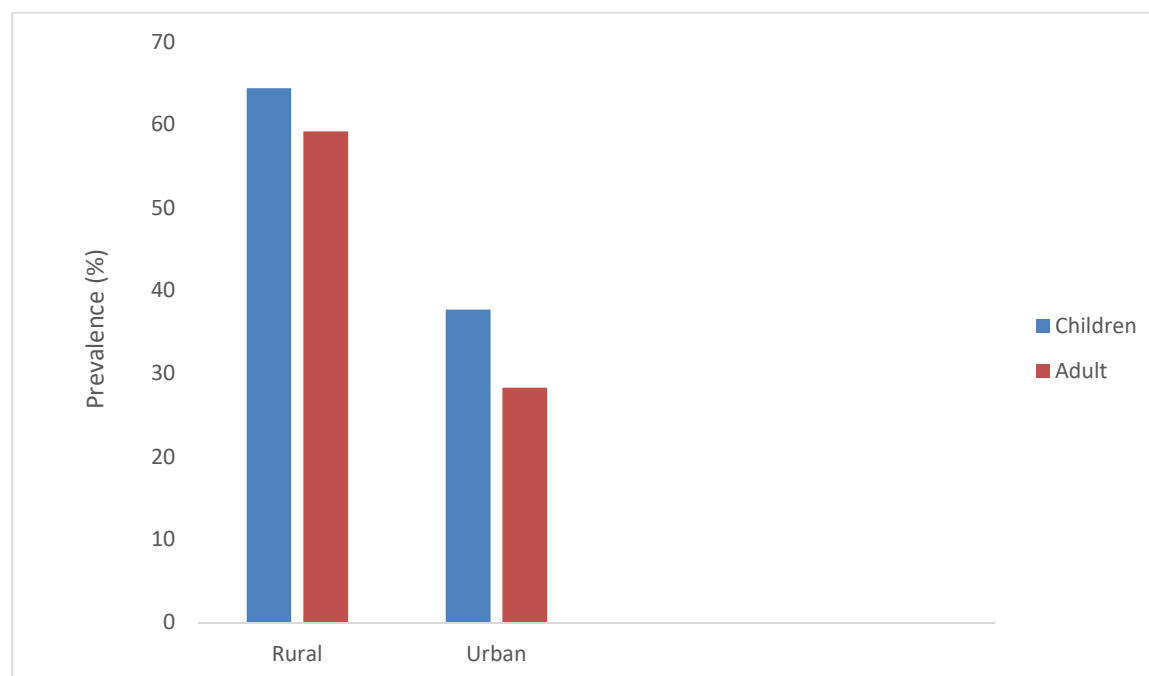


Figure 1: Prevalence of IPIs in children and adults of rural and urban settings

The prevalence rates of infection in male children was (rural: 61.5%, urban: 56.2%) and female (rural: 38.5%, urban: 43.8%) respectively. However, within both rural and urban setting, there was significant statistic difference (Table 1). Rural areas show significantly higher prevalence.

Table 1: Chi-Square Test Results for Prevalence Difference between Rural and Urban Areas (Children)

Area	Infected	Not Infected	$\chi^2$	p-value
Rural	67	37		
Urban	49	81		
<b>Total</b>	<b>116</b>	<b>118</b>	<b>15.46*</b>	<b>&lt;.001</b>

\*Significant at  $p < 0.05$  level;  $df = 1$ .

Of the sampled adults, 59.2% prevalence rate was recorded, with 85.1% infected with *Ascaris lumbricoides*, 62.1% with *Necator americanus*, 21.6% for *Trichuris trichiura*, 8.2% for *Strongyloides stercoralis* and 63.5% for *Entamoeba histolytica* (Table 2). Rural children exhibit significantly higher parasite intensities (2.93) compared to urban children (1.69) (Table 3).

Table 2: Distribution of Intestinal parasites in sampled population in rural and urban settings

Parasite	Children						Adults					
	Rural			Urban			Rural			Urban		
	M (%)	F (%)	Pooled (%)	M (%)	F (%)	Pooled (%)	M (%)	F (%)	Pooled (%)	M (%)	F (%)	Pooled (%)
<i>Ascaris lumbricoides</i>	52.2	32.8	85.1	48.9	30.6	79.6	56.8	28.4	85.1	38.5	19.2	57.7
<i>Necator americanus</i>	41.8	29.9	71.6	20.4	8.2	28.6	45.9	16.2	62.1	30.8	19.2	50
<i>Trichuris trichiura</i>	37.3	26.9	64.2	22.5	10.2	32.7	13.5	8.1	21.6	19.2	7.7	26.9
<i>Strongyloides stercoralis</i>	17.9	7.5	25.4	4.1	6.1	10.2	6.8	1.4	8.2	11.5	3.8	15.3
<i>Entamoeba histolytica</i>	23.9	22.4	46.3	8.2	10.2	1.4	37.88	25.7	63.5	26.9	7.7	34.6

Table 3: Independent Samples t-Test Results for Mean Parasite Intensity between Rural and Urban Areas (Children)

Area	N	Mean	SD	df	t-Cal	t-Crit	p-value
Rural	67	2.93	1.71	114	4.43	1.98	<.001*
Urban	49	1.69	1.30				

\*Significant at  $p < 0.05$  level.

## Discussion

This study examines Intestinal parasitic infections (IPIs) in relation to age, gender and location in remote and urban parts of North-central Nigeria. The overall prevalence in children of the rural settings was 64.4%, which is lower than (83%) reported from Ethiopia (Yami *et al.*, 2011) but higher than report from remote rural (23.6%) and urban (37.7%) parts of North-central Nigeria (Amisu *et al.*, 2023). This could be attributed to the poor state of environmental conditions and waste disposal, poor hygiene practices and exposure to soil. The prevalence in adult in rural area was 59.2% and 28.3% in the urban part. This difference was expected as IPIs vary, where age, region, environmental conditions, level of immunity and evidence of low socio-economic factors play pivotal roles. It was observed in this study that male children and adults had higher cases of infection than female. This could be attributed to their level of involvement in more outdoor activities such as playing with sand, farming and fishing. This is in line with the findings in some parts of Niger state (Mohammed *et al.*, 2014).

The most common parasite in this study is *Ascaris lumbricoides*, which was 85.1% in children and adults in the rural region and 79.6% and 57.7% respectively in the urban area. This was higher in previous study in a remote part of North-central (50.8%) (Amisu *et al.*, 2023) and South-southern (13.0%) parts of Nigeria (Funsho-Aina *et al.*, 2020). Also, the presence of *Necator americanus*, and *Trichuris trichiura* at a relatively high prevalence rate calls for urgent intervention. This could be attributed to a great number of the subjects involved in diverse kinds of agricultural practices coupled with poor hygiene habits and low level of education, which predispose them to this infection.

Interestingly, the high rate of *Ascaris lumbricoides* and *Necator americanus* infections in adults in rural areas as that of the children was unexpected. However, findings in this study show that they are mostly engaged in soil-related activities, which expose their skin to larva penetration. Also, poor hand washing habits, poor waste disposal and management as well as low level of education put them at risk of the infection.

The prevalence of *Strongyloides stercoralis* in children in the rural areas of this study was 25.4%, which was lower (41.1%) compared to school children in the rural part of Amhara Region, Northwest Ethiopia (Jember *et al.*, 2022). However, the level of infection explains the fact that those in the rural areas engage more in outdoor activities and exposure to soil.

The prevalence of *Entamoeba histolytica* in children (46.3%) in rural setting is quite high compared to report from North-central Nigeria (16.9%) (Amisu *et al.*, 2023) but quite lower in rural areas of Benue state (51%) (Funsho-Aina *et al.*, 2020). Considering the peculiar conditions of rural areas which include poor waste disposal system, inadequate water supply and agricultural activities, children in these areas had higher chances of parasitic infections.

In the urban settings, the cases of infection in children could be associated with the conditions in the slum areas of the town, poor access to clean water and sanitary infrastructure in some schools usually attended by the less-privileged in the community. In addition, there is possibility of migration from the rural areas, poor hygiene and low level of education of their parents. Also, there were records of participants resident in the town, who pay frequent visit to the rural areas for farm activities, fishing and other artisanal purposes.

This study elucidates the public health concern posed by IPIs and the urgent need to address it. Improved environmental sanitation conditions, public health education and effective mass drug administration to reduce burden are important in treatment and prevention. The findings of this study could help in strategic treatment and preventive programs, monitoring and surveillance, targeting the population at risk of infections.

### **Conclusion**

This study aims at determining the prevalence of IPIs in children and adults within rural and urban areas of Kontagora, which serve as reliable means for treatment decisions in Mass Drug Administration programmes and surveillance. IPIs are dependent on the environmental and socio-economic conditions of the region, while sex-based differences were not statistically significant. These findings emphasize the need for targeted interventions in rural communities, including enhanced deworming programs and improved sanitation infrastructure.

### **Recommendations**

Good environmental sanitation, proper personal hygiene practices, mass drug administration (MDA) and follow-up programmes should be intensified to prevent and control infections. Schools should

encourage frequent hand washing habits and mass chemotherapy should be adopted to reduce parasite burden and preventive measures should be upheld.

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