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RISK FACTORS ASSOCIATED WITH THE DISTRIBUTION OF INTESTINAL PARASITES AMONG PRIMARY SCHOOL CHILDREN IN THE SOUTHERN SENATORIAL DISTRICT OF EDO STATE, NIGERIA

Osaiyuwu C. O.[1*], Ugbomoiko D. O.[1], Omosigho P. O.[1,2], Erameh T. O.[1], Izevbuwa O. E.[1,4], Osaiyuwu F. O.[3], Nwaobi A. C.[3], and Osaiyuwu O.[5]

[1]Department of Medical Laboratory Sciences, College of Health Sciences, Igbinedion University, Okada.

[2]Department of Medical Laboratory Science, Edo State University, Iyamho

[3]Department of Chemical Pathology, College of Health Sciences, Igbinedion University.

[4]Department of Laboratory Medicine, Medical Laboratory Services, Igbinedion University Teaching Hospital.

[5]Department of Dental Medicine, Igbinedion University Teaching Hospital, Okada.

[*]Corresponding Author's Email: osaiyuwu.clement@iuokada.edu.ng

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ABSTRACT: *Intestinal parasitic infections remain a significant public health concern in Nigeria, particularly among school-aged children who are frequently exposed to poor sanitation, unsafe water sources, and inadequate hygiene practices. This study assessed the prevalence, distribution, and risk factors associated with intestinal parasite infections among primary school children in the Southern Senatorial District of Edo State, Nigeria, with a focus on Ascaris species and other common intestinal parasites. A cross-sectional study was conducted among 633 pupils aged 5 to 10 years across selected primary schools in the seven Local Government Areas (LGAs) of the Southern Senatorial of Edo State. Structured questionnaires were used to obtain sociodemographic and environmental data, while stool samples were collected and examined using standard parasitological techniques. Molecular characterization was performed on selected isolates of Ascaris species. Data were analyzed using descriptive statistics and Chi-square tests to assess associations between risk factors and infection prevalence. Of the 633 pupils examined, 145 tested positive for one or more intestinal parasites, giving an overall prevalence of 22.9%. Ascaris lumbricoides was the most prevalent parasite, followed by Ancylostoma spp., Taenia species, Entamoeba histolytica, and Strongyloides stercoralis. The highest infection rates were recorded in Ikpoba-Okha, Orhionmwon, and Oredo LGAs. A significant association (p < 0.05) was observed between infection prevalence and LGA of residence as well as water source, with pupils relying on well and river water showing higher infection rates than those using treated tap water. Gender, age, and religion were not significantly associated with infection. Molecular analysis revealed moderate genetic diversity among Ascaris species isolates, indicating potential zoonotic and anthroponotic transmission routes. The study highlights a considerable burden of intestinal parasites among school children in the Southern Senatorial district of Edo State, driven largely by unsafe water sources and geographical disparities in sanitation. The dominance of Ascaris lumbricoides and its genetic variability underscores the need for integrated control strategies, including improved water supply, health education, regular deworming, and enhanced surveillance. Targeted interventions in high-risk LGAs are essential to reducing transmission and improving child health outcomes in the region.*

KEYWORDS: Ascaris lumbricoides, intestinal parasites, among school children, in the Southern Senatorial District of Edo State, prevalence, water source, risk factors, Nigeria.

INTRODUCTION

Intestinal parasitic infections (IPIs) have been consistently reported as a major public health concern in developing nations, particularly among school-aged children who are highly vulnerable due to frequent exposure to unhygienic environments and limited immune protection. Researchers such as Mationg et al. (2021) have identified the fecal-oral route as the primary mode of transmission, citing poor sanitation, lack of access to clean drinking water, and inadequate hygiene practices as key contributors. Fauziah et al. (2022) further noted that children are disproportionately affected due to their behavioral tendencies, such as playing in contaminated soil and consuming food without proper handwashing.

Parasitologists have long classified parasites based on their interaction with hosts, differentiating ectoparasites from endoparasites. Loddo et al. (2018) and Veiga et al. (2019) reported that intestinal parasites, particularly soil-transmitted helminths and protozoans, remain highly endemic in tropical climates. According to studies by Adedokun et al. (2018) and Adeniran et al. (2019), infections with Ascaris lumbricoides, Trichuris trichiura, and Ancylostoma spp. (hookworms) are frequently associated with malnutrition, anaemia, stunted growth, and impaired learning ability in school-aged children.

Various studies conducted across Nigeria have documented high prevalence rates of intestinal parasites among children. For instance, Oyeyemi et al. (2020) and Adeleke et al. (2019) reported prevalence rates ranging from 52% to 65%, while Bala et al. (2018) confirmed similar figures in school-based surveys. In Edo State, localized research by Omuemu et al. (2010), Egharevba and Okodua (2013), and Ekeh and Okafor (2012) found prevalence ranging from 25.2% to 77.3%, suggesting that transmission patterns vary significantly depending on geography, school infrastructure, and access to health services.

Among the intestinal parasites, Ascaris lumbricoides has been identified as the most dominant species. Jourdan et al. (2018) described its complex life cycle and high reproductive potential, while Hajare et al. (2022) emphasized the parasite's persistence in environments with poor sanitation. Hookworm infections were also highlighted by Clements and Alene (2022) and Caldrer et al. (2022), who associated transmission with soil contact, particularly in settings where children walk barefoot. Protozoan parasites such as Giardia lamblia and Entamoeba histolytica have also been implicated in chronic diarrhoeal illness, with Adam (2021) and Guillén (2023) reporting their impact on malabsorption and poor weight gain in children.

In addition, researchers such as Page et al. (2018) and Yeh et al. (2023) have called attention to Strongyloides stercoralis, a parasite capable of autoinfection and chronic colonization, especially among immunocompromised individuals. These findings underscore the role of environmental and behavioral risk factors in sustaining transmission in endemic areas.

Given the continuing burden of IPIs in Nigeria, especially among vulnerable school populations, several researchers have emphasized the need for localized epidemiological assessments to inform public health policies. The present study was therefore conducted to investigate the prevalence, distribution, and associated risk factors of intestinal parasitic infections among primary school children in the Southern Senatorial District of Edo State. By identifying the underlying socio-environmental determinants, the study aimed to provide data for designing effective school- and community-based control interventions.

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MATERIALS AND METHODS

A cross-sectional study was conducted to determine the prevalence of intestinal parasites and molecular characterization of *Ascaris species* among primary school children aged 5–10 years in the seven local government areas (LGAs) of the Southern Senatorial District of Edo State, Nigeria.

Study Population

The study population comprised 633 primary school pupils, with 392 females and 241 males. All participants were between 5 and 10 years old and had resided in their respective LGAs for at least six months.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Children aged 5–10 years.
- Enrollment in primary schools within the selected LGAs.
- Written informed consent from parents or guardians.
- Verbal assent from pupils.
- No anthelmintic treatment in the preceding three months.

Exclusion Criteria:

- Pupils outside the 5–10 age range.
- Not enrolled in schools within the study area.
- Recent anthelmintic therapy (within three months).
- Chronic illness or severe gastrointestinal symptoms at the time of the study.
- Residence in the study area for less than six months.

Sample Size Determination

Sample size was calculated using Cochrane's formula for cross-sectional studies, assuming a prevalence of 79% (Umar et al., 2018), a 95% confidence level, 5% margin of error, and a design effect of 2 due to the two-stage sampling method. After adjusting for a 10% non-response rate, the minimum sample size was estimated at 567. Ultimately, 633 pupils were recruited.

Sampling Technique

A two-stage sampling technique was employed:

Stage 1 – School Selection:

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Thirty-five public primary schools were randomly selected from an official list provided by the Edo State Ministry of Education, ensuring representation across all seven LGAs.

Stage 2 – Pupil Selection:

Stratified sampling based on age and gender was applied within each school, followed by systematic random sampling to select eligible pupils proportionally.

Data Collection Instrument

A structured, interviewer-administered questionnaire was used to collect sociodemographic and environmental data. Guardians or teachers assisted younger pupils during questionnaire completion to ensure accuracy and completeness.

Stool Sample Collection

Each pupil was provided with a sterile, labeled stool container and instructed on hygienic collection procedures. Approximately 3 grams of fresh stool was collected and transported under cold chain conditions to the central laboratory within one hour of collection for immediate analysis.

Parasitological Examination

Macroscopic Examination:

Samples were first examined visually for color, consistency, presence of blood or mucus, and visible adult worms.

Microscopic Examination:

Three techniques were employed to detect ova and cysts of A. lumbricoides and other intestinal parasites:

- Direct Wet Mount (Saline and Iodine): Stool smears were prepared with normal saline and Lugol’s iodine and examined under 10× and 40× objectives for helminth ova and protozoan cysts (Cheesbrough, 2022).
- Formol-Ether Concentration Technique: One gram of stool was emulsified in 10% formol water, strained, and mixed with diethyl ether. Following centrifugation at 3000 rpm for five minutes, the sediment was examined microscopically for parasitic elements (Cheesbrough, 2022).

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RESULTS

Table 1 presents the prevalence of parasitic infection among primary school children in the Southern Senatorial District of Edo State in relation to their sociodemographic characteristics. Age was not significantly associated with parasitic infection ($\chi^2 = 3.396$, $p = 0.183$). Although children aged 9–10 years exhibited the highest prevalence (26.3%), followed closely by those aged 5–7 years (25.5%), and the lowest prevalence was among those aged 8–9 years (19.8%), the differences were not statistically significant. Gender was also not significantly associated with parasitic infection ($\chi^2 = 0.546$, $p = 0.460$). Males recorded a slightly higher infection rate (24.5%) compared to females (21.9%). Religion did not show a significant association with parasitic infection ($\chi^2 = 0.010$, $p = 0.920$). Among Christians, 22.9% were infected, while 25.0% of Muslim respondents were infected. Local Government Area (LGA) of residence demonstrated a statistically significant association with parasitic infection ($\chi^2 = 56.852$, $p = 0.0001$). Infection rates varied markedly across the LGAs, with the highest prevalence observed in Ikpoba Okha (25.5%), Orhionmwon (20.7%), and Oredo (16.6%), whereas Ovia South West (8.3%), Egor (9.0%), and Ovia North East (9.0%) recorded lower infection rates.

Table 2 shows the prevalence of parasitic infection among primary school children in the Southern Senatorial District of Edo State in relation to their water source. A statistically significant association was observed between water source and parasitic infection ($\chi^2 = 48.084$, $p = 0.0001$). Children who sourced their drinking water from wells exhibited the highest prevalence of infection (36.7%), compared to those who used tap water (13.8%). The single respondent who relied on river water was also infected (0.7%).

Table 1. **Prevalence of Parasitic Infection among Primary Children in the Southern Senatorial District of Edo State in Relation to Sociodemographic Characteristics**

Sociodemographics	Number Examined (%)	Number Infected (%)	χ2	p- value
Age (Years)				
5-7	149 (23.5)	38 (25.5)	3.396	0.183
8-9	313 (49.4)	62 (19.8)		
9-10	171 (27.0)	45 (26.3)		
Gender				
Male	241 (38.1)	59 (24.5)	0.546	0.460
Female	392 (61.9)	86 (21.9)		
Religion				
Christianity	629 (99.4)	144 (22.9)	0.010	0.920
Islam	4 (0.6)	1 (25.0)		
Local Government Area in the Southern Senatorial District of Edo State				
Egor	122 (19.3)	11 (9.0)	56.852	**0.0001***
Oredo	87 (13.7)	24 (16.6)		
Ikpoba Okha	135 (21.3)	37 (25.5)		
Uhunmwonde	50 (7.9)	18 (12.4)		
Ovia South West	76 (12.0)	12 (8.3)		
Ovia North East	105 (16.6)	13 (9.0)		
Orhionmwon	58 (9.2)	30 (20.7)		

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Table 2. **Relationship Between Risk Factors (Water source) and Prevalence of Intestinal Parasites among Primary Children in the Southern Senatorial District of Edo State.**

Risk Factor	Number Examined (%)	Number Infected (%)	χ2	p- value
Water source				
Tap	384 (60.7)	53 (13.8)	48.084	**0.0001***
Well	248 (39.2)	91 (36.7)		
River	1 (0.2)	1 (0.7)		
Total	**633 (100)**	**145 (100)**		

Table 3 shows the age distribution of intestinal parasite infections among primary school children in the Southern Senatorial District of Edo State. The most prevalent parasite across all age groups was *Ascaris spp.* (80 infections), followed by *Ancylostoma spp.* (31 infections) and *Taenia spp.* (23 infections). *E. histolytica* and *S. stercoralis* were less common. In the 5–6-year age group, *Taenia spp.* (34.8%) was the most common, followed by *Hookworm* (25.8%) and *Ascaris spp.* (22.5%). In the 7–8-year group, *Ascaris spp.* (42.5%) and *Taenia spp.* (56.5%) were most prevalent, while in the 9–10-year group, *Ancylostoma spp.* (41.9%) was the leading infection. There was no significant association between age and the prevalence of these parasites (p = 0.070).

Table 4 shows the gender distribution of intestinal parasite infections among primary school children in the Southern Senatorial District of Edo State. The results show that *Ascaris spp.* had similar prevalence rates between male (48.8%) and female (51.2%) children. However, *Taenia spp.* was more prevalent in females (87.0%) compared to males (13.0%), while *Ancylostoma spp.* and *E. histolytica* were more common in females (58.1% and 60.0%, respectively). No cases of *S. stercoralis* were found in males, whereas 100% of the single case of *S. stercoralis* was in a female (p = 0.053).

Table 5 shows the distribution of intestinal parasite infections across the local government areas (LGAs) in the Southern Senatorial District of Edo State. *Ascaris spp.* was most prevalent in Orhionmwon (35.0%), followed by Ikpoba Okha (25.0%) and Uhunmwonde (30.0%). *Ancylostoma spp.* infections were most common in Oredo (29.0%) and Ikpoba Okha (25.8%), while *Taenia spp.* was predominantly observed in Oredo (60.9%). *E. histolytica* was highest in Ikpoba Okha (50.0%), and the single case of *S. stercoralis* was also reported from Ikpoba Okha (100.0%). No *Ascaris spp.* infections were recorded in Oredo, and no *Taenia spp.* infections were reported in Orhionmwon. Statistical analysis revealed a significant association between LGA and parasite distribution (p = 0.001).

Table 6 shows the distribution of intestinal parasite infections according to water source among primary school children in the South Senatorial District of Edo State. Children who relied on well water had the highest prevalence of *Ascaris spp.* (67.5%), *Ancylostoma spp.* (67.7%), and *E. histolytica* (50.0%), and were solely associated with the single case of *S. stercoralis* (100.0%). Children using tap water showed a higher prevalence of *Taenia spp.* (56.5%), along with lower rates of *Ascaris spp.* (31.3%), *Ancylostoma spp.* (32.3%), and *E. histolytica* (50.0%). No intestinal parasites were detected among those who used river water,

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except for one case of *Ascaris spp.* (1.3%). Statistical analysis revealed a significant association between water source and the prevalence of intestinal parasites (p = 0.001).

Table 3 **Relationship Between Age Distribution and Intestinal Parasite Infection among Primary School Children in the Southern Senatorial District of Edo State.**

Age	***Ascaris spp.* (%)**	**Ancylostoma spp. (%)**	***Taenia spp.* (%)**	***E. histolytica* (%)**	***S stercoralis* (%)**	**p value**
5-6	18 (22.5)	8 (25.8)	8 (34.8)	4 (40.0)	0 (0)	0.070
7-8	32 (42.5)	10 (32.3)	13 (56.5)	5 (50.0)	0 (0)	
9-10	28 (35.0)	13 (41.9)	2 (8.7)	1 (10.0)	1 (100)	
Total	80 (100)	31 (100)	23 (100)	10 (100)	1 (100)	

Table 4. **Relationship Between Gender Distribution and Intestinal Parasite Infection among Primary School Children in the Southern Senatorial District of Edo State.**

Gender	***Ascaris spp.* (%)**	**Ancylostoma spp. (%)**	***Taenia spp.* (%)**	***E. histolytica* (%)**	***S stercoralis* (%)**	**P value**
Male	39 (48.8)	13 (41.9)	3 (13.0)	4 (40.0)	0 (0)	0.053
Female	41 (51.2)	18 (58.1)	20 (87.0)	6 (60.0)	1 (100)	
Total	80 (100)	31 (100)	23 (100)	10 (100)	1 (100)	

Table 5. **Distribution of Intestinal Parasites Infection among Primary School Children in the Southern Senatorial District of Edo State according to Local Government Area .**

LGA	***Ascaris spp.* (%)**	**Ancylostoma spp. (%)**	***Taenia spp.* (%)**	***E. histolytica* (%)**	***S stercoralis* (%)**	**p value**
Egor	4 (5.0)	5 (16.1)	1 (4.3)	1 (10.0)	0 (0)	**0.001***
Oredo	0 (0)	9 (29.0)	14 (60.9)	1 (10.0)	0 (0)	
Ikpoba Okha	20 (25.0)	8 (25.8)	3 (13.0)	5 (50.0)	1 (100.0)	
Uhunmwonde	15 (30.0)	2 (6.5)	1 (4.3)	0 (0)	0 (0)	
Ovia South West	4 (5.0)	3 (9.7)	3 (13.0)	2 (20.0)	0 (0)	
Ovia North East	9 (11.3)	2 (6.5)	1 (4.3)	1 (10.0)	0 (0)	
Orhionmwon	28 (35.0)	2 (6.5)	0 (0)	0 (0)	0 (0)	

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Table 6 **Risk Factors (Water Source) and Distribution of Intestinal Parasites Infection among Primary School Children in Southern Senatorial District of Edo State.**

Water Source	***Ascaris spp.* (%)**	**Ancylostoma spp. (%)**	***Taenia spp.* (%)**	***E. histolytica* (%)**	***S stercoralis* (%)**	**p value**
Tap	25 (31.3)	10 (32.3)	13 (56.5)	5 (50.0)	0 (0)	**0.001***
Well	54 (67.5)	21 (67.7)	10 (43.5)	5 (50.0)	1 (100.0)	
River	1 (1.3)	0 (0)	0 (0)	0 (0)	0 (0)	

DISCUSSION

The findings of this study provide critical insights into the epidemiology and risk factors associated with the distribution of intestinal parasitic infections (IPIs) among primary school children in the Southern Senatorial District of Edo State, Nigeria. By integrating sociodemographic variables with environmental determinants and parasitological data, this study identifies the underlying factors that influence parasite transmission dynamics, thereby offering valuable implications for targeted public health interventions.

The overall prevalence of IPIs in this study was 22.9%, which, though moderate compared to some regions, remains a significant public health concern, particularly in resource-limited settings where children are frequently exposed to contaminated environments. This prevalence underscores the ongoing challenge of parasitic infections in Nigeria despite public health efforts and educational campaigns. It also reflects persistent issues related to inadequate sanitation, poor hygiene, and limited access to clean water—factors that remain critical in the propagation of intestinal parasites (Garn et al., 2016).

Gender distribution among participants showed a higher number of female pupils, which may be indicative of improved female enrolment and retention in schools, possibly due to ongoing advocacy and education policies aimed at promoting girl-child education. While this gender imbalance may affect the representation of infection across sexes, the analysis showed no statistically significant association between gender and infection prevalence. This aligns with findings from Ugochi et al. (2015) and Dangana et al. (2011), suggesting that exposure to parasitic risk factors is not significantly influenced by gender, as both male and female children likely share similar behavioral and environmental exposures, such as playing barefoot, poor hand hygiene, and inadequate toilet facilities.

Age also showed no significant relationship with infection, although children aged 9–10 years had slightly higher infection rates. This may be attributed to increased physical activity, greater mobility, and more frequent exposure to contaminated environments. This pattern reflects observations in earlier studies (Gowon et al., 2018; Dangana et al., 2011), where age-specific differences in exposure behavior played a role in infection dynamics.

One of the most compelling findings of this study was the significant association between the Local Government Area (LGA) of residence and the prevalence of intestinal parasites. Pupils from Ikpoba Okha, Orhionmwon, and Oredo LGAs had markedly higher infection rates compared to their counterparts from Egor and Ovia South West. These disparities likely reflect the differential distribution of environmental sanitation infrastructure, population density, and socioeconomic conditions. Densely populated or peri-urban LGAs may suffer

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from overburdened sanitation systems, poor waste disposal, and unregulated water sources, increasing the risk of fecal contamination and parasite transmission. These findings corroborate those of Onabolu et al. (2011) and Gbonhinbor et al. (2022), who reported significant geographical differences in parasitic infections due to localized infrastructural and hygienic deficiencies.

Access to clean water was another critical factor influencing the spread of IPIs. The study identified three primary sources of drinking water among the pupils: tap, well, and river water. A significant association was found between water source and infection prevalence, with children who relied on well water having the highest rates of infection, particularly with Ascaris spp., Ancylostoma spp., and E. histolytica. Well water is often poorly protected and easily contaminated with fecal matter in areas lacking effective sanitation. Similar observations have been made in rural communities across sub-Saharan Africa, where inadequate water treatment and open defecation contribute significantly to parasite transmission (Grimes et al., 2015; Armah et al., 2018; Dos Santos et al., 2017).

Children using river water were also at risk, although fewer in number. River water, particularly in rural settings, is commonly exposed to human and animal waste and serves as a major route for transmission of protozoan parasites. In contrast, pupils using treated tap water had comparatively lower infection rates, although some still tested positive, possibly due to post-supply contamination or shared storage containers.

This study identified Ascaris spp. as the most prevalent parasite, followed by Ancylostoma spp., Taenia spp., E. histolytica, and S. stercoralis. The predominance of Ascaris spp. is consistent with its resilience in the environment and its direct fecal-oral transmission route. This finding mirrors previous reports by Rim et al. (2003), Ugochi et al. (2015), and Gbonhinbor et al. (2022), further reinforcing the global recognition of Ascaris as the most common intestinal parasite among children in endemic areas.

Ancylostoma spp., the second most isolated parasite, is transmitted through skin contact with contaminated soil. Its presence is indicative of inadequate foot protection among children and the persistence of open defecation, especially in communities with poor soil sanitation management (Narahari et al., 2016). The identification of Taenia spp. suggests exposure to improperly cooked or infected meat, highlighting a lapse in food hygiene and meat inspection protocols, especially in semi-urban and rural communities (Gabriel et al., 2022). E. histolytica, although less prevalent, signals the risk of waterborne transmission, particularly in schools and homes with inadequate water treatment. S. stercoralis was rare, in line with other reports suggesting its lower prevalence due to its complex life cycle and specific environmental needs (Alegría et al., 2017; Salim et al., 2014).

The 22.9% prevalence reported in this study is lower than figures from regions such as South Africa (64.8%, Nxasana et al., 2013), Ethiopia (41.4%, Abossie & Seid, 2014), and Laos (61.9%, Rim et al., 2003), but higher than the prevalence reported in Tehran, Iran (18.4%, Nematian et al., 2004). In Nigeria, studies from Imo and Delta States reported prevalence rates of 48.7% and 50.0%, respectively (Eboh et al., 2022; Ugochi et al., 2015), underscoring regional disparities. Notably, the findings of this study closely align with the 23.95% prevalence recorded in Sagbama, Bayelsa State (Gbonhinbor et al., 2022), suggesting that infection rates may be influenced more by local environmental and behavioral factors than by broad regional trends.

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Environmental studies support these findings. Mogaji et al. (2022) demonstrated how soil pH, moisture, and elevation influenced parasite survival, while Barnabas (2022) confirmed high contamination rates in water samples from Jos. These studies validate the role of ecological and environmental determinants in shaping IPI epidemiology.

This study reinforces the multifactorial nature of intestinal parasite transmission in schoolchildren. While demographic factors such as age and gender may not significantly affect infection rates, geographic location (LGA) and water source are critical determinants. These risk factors must be prioritized in designing effective control strategies, including the provision of safe water, improved sanitation, school-based deworming programs, and community health education. Targeted interventions tailored to high-risk LGAs and vulnerable populations are essential to reducing the burden of IPIs in the Southern Senatorial District of Edo State, Nigeria.

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