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Prevalence and Sociodemographic Characteristics of Intestinal Parasitic Infections Associated with School Age Children in the Southern Senatorial District of Edo State, Nigeria

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Abstract

Intestinal parasitic infections remain a significant public health concern among children in many developing countries, contributing to malnutrition, impaired growth, and reduced academic performance. This study investigated the prevalence of intestinal parasitic infections among primary school children in the South Senatorial District of Edo State, Nigeria. A total of 633 pupils aged 5–10 years were selected through a two-stage random sampling technique from 35 public primary schools across seven Local Government Areas. Stool samples were examined using standard macroscopic and microscopic techniques, including saline, iodine, and formol-ether concentration methods. The overall prevalence of intestinal parasites was 22.9%. Ascaris lumbricoides was the most commonly detected parasite, accounting for 55.2% of cases, followed by Ancylostoma spp. (21.4%), Taenia spp. (15.9%), Entamoeba histolytica (6.9%), and Strongyloides stercoralis (0.7%). Prevalence varied across LGAs, with Ikpoba Okha (25.5%), Orhionmwon (20.7%), and Oredo (16.6%) recording the highest rates. Children who relied on well water had significantly higher infection rates (36.7%) compared to those using tap water (13.8%). The only child using river water also tested positive. Although not statistically significant, infection rates were slightly higher in males (24.5%) than females (21.9%), with the highest burden observed among children aged 9–10 years (26.3%). These findings underscore the continued burden of intestinal parasitic infections among school-aged children in the region and highlight the urgent need for enhanced public health interventions, including improved sanitation, access to clean water, health education, and regular school-based deworming programs.

Introduction

Parasites are diverse organisms that live on or within a host, deriving nutrients at the host's expense. They range in complexity from microscopic protozoa to macroscopic helminths and arthropods, and have evolved various adaptive mechanisms to evade host defenses, manipulate immune responses, and alter host behavior (Becker et al., 2018). While parasites play integral roles in ecosystems, their impact on human and animal health remains profound, especially in regions with limited access to healthcare and sanitation (Giari et al., 2020; Cock et al., 2018).

Parasitic diseases, particularly those caused by intestinal parasites, continue to present serious public health challenges in developing countries. These diseases are primarily transmitted through the fecal-oral route, with risk factors including poor sanitation, inadequate access to clean water, and substandard hygiene practices (Mationg et al., 2021). Children are particularly vulnerable due to their immature immune systems and frequent exposure to contaminated environments, especially in school settings with insufficient sanitary infrastructure (Fauziah et al., 2022).

Parasites are broadly classified as ectoparasites or endoparasites based on their location on or within the host. Further classification considers life cycle complexity and host specificity, with some parasites exhibiting direct life cycles and others requiring multiple hosts (Loddo et al., 2018; Veiga et al., 2019). Among intestinal parasites, Ascaris lumbricoides, Trichuris trichiura, and hookworms are the most prevalent and clinically significant in Nigeria, causing malnutrition, anaemia, impaired cognitive

development, and decreased school performance among children (Adedokun et al., 2018; Adeniran et al., 2019).

Several regional studies across Nigeria have reported high prevalence rates of intestinal parasitic infections among school-aged children, ranging from 52% to 65% (Oyeyemi et al., 2020; Adeleke et al., 2019; Bala et al., 2018). In Edo State, prevalence rates have varied between 25.2% and 77.3%, depending on location and population studied (Omuemu et al., 2010; Egharevba & Okodua, 2013; Ekeh & Okafor, 2012). Notably, a study in Ovia North-East LGA reported a prevalence of 58.7%, with the highest burden among children aged 5–10 years (Egharevba & Okodua, 2013).

Ascaris lumbricoides, the most widespread soil-transmitted helminth, inhabits the human small intestine and causes ascariasis. Transmission occurs via ingestion of eggs in contaminated food or soil. The parasite's life cycle includes a complex pulmonary migration phase before settling in the gut, where adult worms can grow up to 30 cm and lay thousands of eggs daily (Jourdan et al., 2018; Hajare et al., 2022). Other major parasites, such as Trichuris trichiura and hookworms, contribute to chronic gastrointestinal symptoms, anaemia, growth retardation, and impaired cognitive development (Caldrer et al., 2022; Clements & Alene, 2022).

Protozoan parasites also play significant roles in intestinal morbidity. Giardia lamblia and Entamoeba histolytica cause giardiasis and amoebiasis respectively, both of which are associated with diarrhoea, malabsorption, and failure to thrive in children (Adam, 2021; Guillén, 2023). Strongyloides stercoralis, a unique nematode with autoinfective capacity, can persist chronically and cause life-threatening disseminated infections in immunocompromised hosts (Page et al., 2018; Yeh et al., 2023).

Given the persistent burden of intestinal parasitic infections in Nigeria, particularly among children, there is an urgent need to understand their epidemiology at the local level. This study aims to determine the prevalence and distribution of intestinal parasites among primary school children in the Southern Senatorial District of Edo State, Nigeria, to inform targeted control strategies and health interventions.

Materials and Methods

A descriptive cross-sectional study was conducted to determine the prevalence and molecular characterization of Ascaris lumbricoides among primary school children in the Southern Senatorial District of Edo State, Nigeria.

Study Location

Edo South Senatorial District is one of the three senatorial districts in Edo State, located in the South-South geopolitical zone of Nigeria. It comprises seven local government areas (LGAs): Oredo, Egor, Ikpoba-Okha, Uhunmwonde, Ovia South-West, Ovia North-East, and Orhionmwon. The region is predominantly urban and semi-urban, with a mix of public and private primary schools. The area has a tropical climate, characterized by distinct wet and dry seasons, and faces ongoing public health challenges related to water, sanitation, and hygiene infrastructure, making it a suitable site for parasitological studies.

Selection Criteria

Inclusion Criteria:

1. Pupils aged 5–10 years.
2. Enrollment in primary schools within the seven LGAs of Edo South.
3. Written informed consent from parents/guardians and assent from pupils.
4. No history of anthelmintic treatment within three months.
5. Residency in the selected LGAs for at least six months.

Exclusion Criteria:

1. Pupils outside the 5–10-year age range.
2. Pupils not enrolled in primary schools in the study area.
3. Lack of consent/assent.
4. Recent anthelmintic drug use.
5. Chronic illnesses or severe diarrhoea at the time of sample collection.
6. Less than six months' residence in the study area.

Study Population

A total of 633 pupils (392 females and 241 males), aged 5–10 years, from selected public primary schools across the seven LGAs of Edo South were enrolled.

Sampling Technique

A two-stage sampling method was employed:

Stage 1: School Selection

Primary schools were selected using simple random sampling from a list provided by the Edo State Ministry of Education. Schools were chosen across the seven LGAs, ensuring geographic representation.

Stage 2: Pupil Selection

Within selected schools, pupils were stratified by age (5–6, 7–8, 9–10 years) and gender. Proportional allocation was used to determine the number of participants per stratum. Systematic random sampling was then used within each stratum to select participants from school registers.

Method of Data Collection

Structured questionnaires were administered to pupils under the supervision of their teachers or guardians to gather sociodemographic and hygiene-related information.

Sample Collection

Labeled, sterile stool containers were distributed to participants, who were instructed to provide about 3 grams of fresh stool. Samples were transported within one hour to the laboratory and processed immediately.

Sample Examination

Macroscopic Examination

Stool samples were assessed for color, consistency, presence of blood or mucus, and visible adult parasites.

Microscopic Examination

Three techniques were employed:

a) Saline Smear: A saline suspension of stool was prepared on a slide and examined under ×10 and ×40 objectives for ova and larvae (Cheesbrough, 2022).

b) Iodine Smear: Lugol's iodine was used to stain stool smears, enhancing visualization of cysts and ova (Cheesbrough, 2022).

c) Formol-Ether Concentration: Approximately 1 g of stool was emulsified in formol water, sieved, and centrifuged with ether to concentrate ova. Sediments were examined microscopically for parasites (Cheesbrough, 2022).

RESULTS

Prevalence of Intestinal Parasites

A total of 633 primary school children were included in the study. The age distribution showed that 23.5% of the respondents were between 5 and 7 years, 49.4% were between 8 and 9 years, and 27.0% were between 9 and 10 years. In terms of gender, 38.1% were male and 61.9% were female. Regarding religious affiliation, the majority of respondents (99.4%) identified as Christians, while only 0.6% identified as Muslims. Participants were drawn from seven Local Government Areas within the Edo South Senatorial District: Egor (19.3%), Oredo (13.7%), Ikpoba Okha (21.3%), Uhunmwonde (7.9%), Ovia South West (12.0%), Ovia North East (16.6%), and Orhionmwon (9.2%) (Table 4.1). Ugbowo Primary School recorded the highest number of respondents (approximately 47), followed by Ozolua Primary School (around 37) and Ogida MPS (approximately 33). These top three schools contributed a substantial proportion of the total respondents. Following closely are Uvbi PS, Egba, Obazagbon, Ekhiri, and Eresoyen, each contributing similar numbers (around 30 respondents each). Other schools such as Lucy, Idogbo, Uwa PS, and Azogba show slightly lower but comparable numbers, ranging from approximately 25 to 30 respondents. The majority of respondents, 384 (60.7%), reported using tap water as their main source of drinking water. Well water was utilized by 248 (39.2%) of the respondents, while river water was the least reported source, accounting for only 1 (0.2%) of the total respondents (Figure 4.1).

Out of the 633 primary school children examined, 145 (22.9%) tested positive for parasitic infections, while 488 (77.1%) were negative (Figure 4.2). Among the 145 infected primary school children, Ascaris lumbricoides was the most frequently identified parasite, accounting for 55.2% of infections. Hookworm was detected in 21.4% of the cases, while Taenia species were identified in 15.9% of the infected children. Entamoeba histolytica accounted for 6.9% of infections, whereas Strongyloides stercoralis was the least prevalent parasite, detected in only 0.7% of cases (Table 4.2).

Table 1. **Sociodemographic Characteristics and Risk Factors (Water Source) of Respondents**

Variable	Frequency	Percentage
Age (Years)		
5-7	149	23.5
8-9	313	49.4
9-10	171	27.0
Total	**633**	**100.0**
Gender		
Male	241	38.1
Female	392	61.9
Total	**633**	**100.0**
Religion		
Christianity	629	99.4
Islam	4	0.6
Total	**633**	**100.0**
Local Government Area in the Southern Senatorial District of Edo State		
Egor	122	19.3
Oredo	87	13.7
Ikpoba Okha	135	21.3
Uhunmwonde	50	7.9
Ovia South West	76	12.0
Ovia North East	105	16.6
Orhionmwon	58	9.2
Total	**633**	**100.0**
Water Source		
Tap	384	60.7
Well	248	39.2
River	1	0.2
Total	**633**	**100.0**

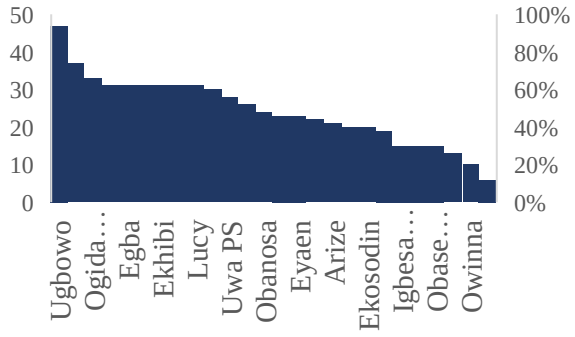

Figure .1. Distribution of Respondents from different primary schools across the southern senatorial district of Edo State.

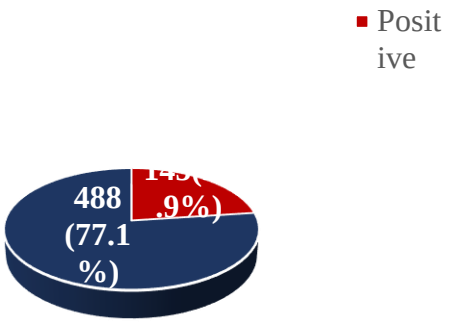

Figure .2. Prevalence of Intestinal parasites among primary school children in the Southern Senatorial zone of Edo State.

Table.1. **Distribution of Intestinal Parasites among Infected Primary School Children in the Southern Senatorial Zone of Edo state**

Parasites	Frequency	Percentage
Ascaris species.	80	55.2
Ancylostoma spp.s	31	21.4
Taenia species	23	15.9
Entamoeba histolytica	10	6.9
Strongyloides stercoralis	1	0.7
Total	**145**	**100.0**

Table.3 presents the prevalence of parasitic infection among primary school children in Edo South Senatorial District in relation to their sociodemographic characteristics. Age was not significantly associated with parasitic infection (χ^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 (χ^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 (χ^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 (χ^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 4 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 (χ^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 2.Relationship Between Socio-demographic Factors and **Prevalence of Intestinal Parasite among Primary school Children in the Southern Senatorial District of Edo State.**

Socio-demographics	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)		

* Represents statistical significance at $p<0.05$

Table 3.Relationship Between Risk Factors (Water Source) and **Prevalence of Intestinal Parasite among Primary school 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)**		

* Represents statistical significance at $p<0.05$

Discussion

The findings of this study provide critical insights into the epidemiology and molecular characteristics of intestinal parasitic infections (IPIs) among primary school children in the Southern Senatorial District of Edo State, Nigeria. By integrating demographic, environmental, parasitological, and molecular data, this study offers a comprehensive understanding of the burden, distribution, and diversity of intestinal parasites in the region. These insights are crucial for informing public health strategies and guiding targeted interventions aimed at reducing the transmission of IPIs among vulnerable pediatric populations.

A significant gender disparity was observed among the study participants, with female pupils outnumbering males. This overrepresentation may reflect better

school enrollment and retention rates for girls in the study area, possibly due to gender-focused educational initiatives or sociocultural shifts that encourage female education. While some studies corroborate this trend (e.g., Pal, 2010; Kazeem et al., 2010), others report near-equal gender representation in school-based studies (Gowon et al., 2018; Dangana et al., 2011). In contrast, in rural communities, boys are sometimes more engaged in labor-intensive roles or agricultural activities, resulting in lower classroom attendance and thereby impacting gender distribution in school-based surveys.

Local Government Area (LGA) representation in the study showed that pupils from Egor, Ikpoba-Okha, and Ovia North-East LGAs were most represented, while Uhunmwonde had the least. This disparity can be attributed to differences in population density, number of public schools, and ease of access to educational infrastructure. Urban LGAs generally benefit from better access to education, healthcare, and sanitation, which are essential factors influencing both school attendance and disease transmission. Conversely, rural LGAs like Uhunmwonde may face infrastructural challenges, longer travel distances to school, and lower socioeconomic indices, all of which impact school participation and public health outcomes.

The age distribution of the children (predominantly 7 to 9 years) aligns with standard primary school enrollment patterns in Nigeria, corroborating similar observations in previous studies (Gowon et al., 2018; Dangana et al., 2011). This age group is particularly vulnerable to parasitic infections due to underdeveloped hygiene practices, frequent exposure to contaminated environments, and behavioral tendencies such as playing barefoot or failing to wash hands after defecation.

One of the key environmental variables assessed in this study was the source of drinking water, which varied significantly among participants. Pupils reported accessing tap water, well water, and river water. The reliance on well and river water—particularly in rural or peri-urban LGAs—raises concerns, as these sources are more susceptible to contamination from open defecation, agricultural runoff, and unprotected storage. The use of river water is especially alarming, as it is strongly linked with waterborne diseases, including protozoal and helminthic infections (Dos Santos et al., 2017; Ntouda et al., 2013). Tap water, although perceived as safer, may still pose a risk in areas where municipal supply is intermittent or poorly maintained. Such variability in water access plays a central role in the transmission dynamics of intestinal parasites.

The religious homogeneity of the participants—predominantly Christian—reflects the sociocultural context of the Southern Senatorial District of Edo State, where Christianity is the dominant faith. This demographic finding is consistent with that of Asaolu et al. (2002) and, while not directly influencing parasitic infections, may have indirect implications through faith-based hygiene education and health outreach programs.

From a parasitological standpoint, the study recorded a prevalence of 22.9% (145 out of 633 pupils), indicating a moderate but concerning burden of intestinal parasitic infections in the population. While lower than rates reported in some regions—such as South Africa (64.8%) by Nxasana et al. (2013), Ethiopia (41.4%) by Abossie and Seid (2014), or Laos (61.9%) by Rim et al. (2003)—this prevalence still represents a significant public health issue. Conversely, it is higher than that recorded in Tehran, Iran (18.4%) by Nematian et al. (2004), emphasizing the regional variation in parasite burden influenced by hygiene infrastructure, climate, socioeconomic status, and health literacy.

Within Nigeria, the 22.9% prevalence observed aligns closely with the 23.95% reported by Gbonhinbor et al. (2022) in Bayelsa State but contrasts sharply with higher rates in Imo (48.7%) and Delta (50.0%) states (Eboh et al., 2022; Ugochi et al., 2015). These discrepancies may stem from environmental, behavioral, or methodological differences across regions, including sampling techniques, diagnostic sensitivity, and seasonal timing of the studies.

The spectrum of intestinal parasites identified included Ascaris lumbricoides, Ancylostoma spp., Taenia species, Entamoeba histolytica, and Strongyloides stercoralis. Ascaris lumbricoides was the most prevalent, consistent with earlier findings across Nigeria and other sub-Saharan countries (Rim et al., 2003; Ugochi et al., 2015; Gbonhinbor et al., 2022). Its dominance is often linked to persistent soil contamination, poor sanitation practices, and the parasite's resilience in varied environmental conditions. The transmission of Ascaris is typically fecal-oral, facilitated by inadequate hand hygiene and open defecation, especially in communities lacking latrine facilities.

Hookworm infections were the second most common. These parasites are transmitted via skin penetration, particularly through walking barefoot on contaminated soil—a common behavior among children. The warm, humid climate of southern Nigeria further supports larval development in the soil, enhancing transmission potential (Narahari et al., 2016).

Taenia species, though less prevalent, highlight the continued risk of taeniasis due to poor meat inspection practices and the consumption of undercooked pork or beef. The presence of Entamoeba histolytica—a waterborne protozoan—confirms that protozoal infections persist in some communities, albeit at a lower rate, likely due to partial improvements in water safety. Strongyloides stercoralis was the least detected, consistent with other studies reporting its lower prevalence in school-age children, possibly due to its more complex lifecycle and requirement for specific ecological conditions (Alegría et al., 2017; Salim et al., 2014).

Among the sociodemographic and environmental variables analyzed, the LGA of residence emerged as a significant determinant of infection risk. Pupils from Ikpoba-Okha, Orhionmwon, and Oredo recorded the highest infection rates. These variations may reflect differences in sanitation infrastructure, access to clean water, hygiene education, and community health practices across LGAs (Onabolu et al., 2011). This observation is in line with Gbonhinbor et al. (2022), who found significant spatial heterogeneity in parasitic infection prevalence across nine communities.

Other variables—such as age, gender, and religion—did not show statistically significant associations with parasitic infections, although marginal differences were noted. This may indicate a relatively uniform exposure to risk factors across groups or the possibility that environmental variables exert a stronger influence than individual demographics—a finding also supported by Ugochi et al. (2015).

Water source, on the other hand, showed a significant association with infection prevalence. Pupils using well water had a notably higher risk of infection than those with access to tap water, underscoring the need for improved water quality management. These findings align with studies by Grimes et al. (2015) and Fuhrimann et al. (2016), which emphasized the role of unsafe water in sustaining parasitic transmission cycles.

In conclusion, the results of this study underscore the continuing burden of intestinal parasitic infections among schoolchildren in Edo South, with Ascaris lumbricoides as the predominant species. The findings emphasize the urgent need for integrated control strategies, including mass deworming programs, improved water and sanitation infrastructure, health education, and periodic surveillance incorporating both microscopy and molecular diagnostics. Future research should also focus on genotype-specific behavior of Ascaris and other parasites to better understand patterns of resistance, reinfection, and pathogenicity.

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