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Intestinal parasitic infections among children living in foster homes in Calabar: A cross-sectional study

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Abstract

Intestinal Parasitic Infections (IPIs) are a major global health concern. Although WHO recommends mass administration of medicines (albendazole or mebendazole) to control soil-transmitted helminths in children, foster children are often overlooked. This study investigated the prevalence and risk factors of intestinal parasites among children in orphanages in Calabar, Nigeria. A cross-sectional study was conducted among 260 children in registered orphanages from March to August 2024. Data on socio-demographics and hygiene practices were collected via structured questionnaires and interviews. Stool samples were analysed using standard methods. Data were analysed with descriptive statistics, Chi square, odds ratio and binomial logistic regression. The overall prevalence of infection was 23.5% (n=61), higher among females (24.6%) and children aged 10 years and above (33.6%, p=0.001). *Ascaris lumbricoides* (11.5%) and hookworm (6.5%) were the most common parasites. *Entamoeba histolytica* was the most frequently detected protozoan parasite (3.5%, n=20). Poor hand washing before eating (OR=4.53, p<0.0001) and after toilet use (OR=4.96, p<0.0001) increased infection risk. Health education and targeted control programmes are essential for reducing IPIs in children resident in institutionalised homes.

Introduction

Intestinal Parasitic Infections (IPIs) represent a significant global public health challenge, and are generally categorised into protozoans and helminths infections (Ahmed 2023). According to WHO (2020), approximately 1.5 billion people are affected by IPIs, primarily caused by soil-transmitted helminths (STHs) such as *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), *Ancylostoma duodenale*, and *Necator americanus* (hookworms). In certain regions of sub-Saharan Africa (SSA), more than half of the population is affected by IPIs, with *Giardia lamblia*, *Entamoeba histolytica*, and *Cryptosporidium parvum* being the most prevalent intestinal protozoan infections (Hemphill *et al* 2019).

While IPIs affect all age groups, school-age children exhibit the highest prevalence and intensity of infections (Njoku *et al* 2022). Among school children, Usang *et al* (2025) documented an overall prevalence of 28.8% for STHs, with *Ascaris lumbricoides* being the most prevalent at 19.6%. Similarly, Dagne and Alelign (2021) reported a 46.8% prevalence rate for intestinal protozoan infections in school children. Children living in institutional care settings are particularly vulnerable to these infections (Nwaneri and Omuemu 2013).

Intestinal Parasitic Infections pose significant health risks for children, leading to complications such as iron-deficiency anaemia, Vitamin A deficiency, diarrhoea, dysentery, malnutrition, stunted growth, and mental health challenges (Kiani *et al* 2016). Factors influencing the prevalence of IPIs include environmental conditions, geographical location, family education levels and income, access to clean water, health education, and hygiene practices such as hand washing before meals and after using the toilet (Auta *et al* 2013; Asemahagn 2014).

Epidemiological studies confirm that school-age children are at considerable risk of IPIs (Usang *et al* 2025). Among these children are orphans and those categorised as vulnerable, including those who have lost one or both parents, abandoned, or whose parents' whereabouts are unknown (UNICEF 2014). The Ministry of Women Affairs and Social Development estimated that Nigeria is home to 17.5 million orphans and vulnerable children (USAID 2020). These children, particularly those in orphanages, face higher risks of IPIs due to exposure to contaminated soil, poor hygiene practices, and consuming food or water with soiled hands (Nwaneri and Omuemu 2013).

Calabar comprises both urban and peri-urban settings (Imalele *et al* 2020). Within the city, the Ministry of Women Affairs and Social Development manages numerous orphanages of varying capacities and ownership types. This includes those operated by the government, private entities, non-governmental organizations (NGOs), and religious organisations (Okon *et al* 2020). These facilities provide care for orphans, abandoned children, and vulnerable children whose families are unable to support them due to financial constraints. The infrastructure of these orphanages ranges from small-scale homes to larger establishments equipped with essential amenities such as housing, and recreational areas. However, many of these institutions face persistent challenges, including insufficient infrastructure and constrained financial resources (Cross River State Ministry of Women Affairs, 2025).

In regions where intestinal parasites are endemic, WHO advises Mass Administration of Medicines (MAM) namely, albendazole or mebendazole to control intestinal parasites, particularly soil-transmitted helminths (STH) among pre-school and school-age children (WHO 2012). However, this approach often excludes out-of-school children and those living in institutionalised settings such as orphanages. These groups may act as reservoirs for reinfection following the implementation of successful MAM programmes. It is crucial to evaluate the prevalence of IPIs among children in foster care, as this information will guide in developing future policies aimed at controlling IPIs in endemic areas. This study, therefore, investigated the prevalence and risk factors of IPIs in children living in orphanages in Calabar, Nigeria.

Materials and methods

Study area

The study was conducted in Calabar, the administrative capital of Cross River State, located in Nigeria's South-South geopolitical zone (4°57'0"N; 8°19'30"E) (Imalele *et al* 2020). The city is characterised by a tropical climate, marked by a prolonged wet season and a brief dry season, with an average annual temperature of 28°C and roughly 3000mm of rainfall annually. Calabar comprises both urban and peri-urban settings (Imalele *et al* 2020). Within the city, the Ministry of Women Affairs and Social Development manages numerous orphanages of varying capacities and ownership types, including those operated by the government, private entities, non-governmental organizations (NGOs), and religious organisations (Okon *et al* 2020).

Study design

The study was a descriptive, cross-sectional survey, conducted among children residing in registered foster homes in Calabar, Cross River State, over a six-month period (March to August, 2024). The study utilised data from four randomly selected registered orphanages in Calabar (Figure 1) and the names were abbreviated into acronyms to preserve confidentiality. These included MSWMBH (Latitude: 4° 56′ 37″ N; Longitude: 8° 20′ 5″ E), IJOH (Latitude: 4° 57′ 25.60″ N; Longitude: 8° 20′ 1.26″ E), BHFOH (Latitude: 4° 56′ 58″ N; Longitude: 8° 20′ 6″ E), and ROH (Latitude: 4° 56′ 29.7″ N; Longitude: 8° 20′ 21.3″ E). Participants were selected using a systematic sampling method from the rosters of each orphanage. The age range of participants was 5 to 17 years, and for analysis, they were grouped into three age categories: 5-7 years, 8-10 years, and above 10 years, following the age classification used in a similar study by Imalele *et al* (2023).

Sample size determination

The sample size for this study was calculated using the formula outlined by Usang *et al* (2025); $N = Z^2 (PQ/I^2)$ where N represents the sample size; I is the margin of error (0.05); Q is 1-p; Z is the standard normal deviation set at 1.96 for 5% significance level; and P is the baseline prevalence of intestinal parasites among children living in orphanages (20.7%) (Nwaneri and Omuemu, 2013). The minimum required sample size was determined to be 252, and a total of 260 participants were recruited for the study. The sample size was distributed proportionally as follows: 62 participants from MSWMBH, 66 from IJOH, 64 from BHFOH, and 68 from ROH.

Inclusion and exclusion criteria

The study population consisted of children aged 5 to 17 years residing in institutional care facilities. Children who had spent less than three months in these institutions were not included in the study.

Ethical considerations

This study adhered to the principles outlined in the Helsinki Declaration and received ethical clearance from the Ethics and Research Committee of the Cross River State Ministry of Health under REC number CRSMOH/HRP/REC/2024/512. Furthermore, formal authorisation was obtained from the Cross River State Ministry of Women Affairs and Social Development, alongside written consent from the proprietary of the orphanages included in the study.

Data collection

Questionnaire administration

Information on the socio-demographic characteristics of the participants was obtained using structured questionnaire. This questionnaire was adapted from the study by Usang *et al* (2025). Individual interviews were conducted to gather details about their hygiene practices. The interviewer-administered questionnaires also captured data on the sanitation facilities in each orphanage, including the availability and type of toilets, access to water, and the provision of soap for hand washing. Two trained health workers facilitated the process, with assistance from the orphanage caretakers. One health worker read the instructions and questions aloud to the children, while the second health extension worker and a caretaker ensured that all participants comprehended the instructions and provided accurate responses.

Parasitological examination

Each participant was provided with a sterile, labelled, leak-proof stool collection container and was instructed to submit a morning stool sample approximately the size

of a thumb the following day or, if unavoidable, within two days. The collected stool samples were retrieved from each participant and transported in a temperature-controlled container to the laboratory of the Department of Zoology and Environmental Biology at the University of Calabar. Each sample was examined for intestinal parasites using wet mount preparation, the Formol-Ether concentration method, and the Kato-Katz technique.

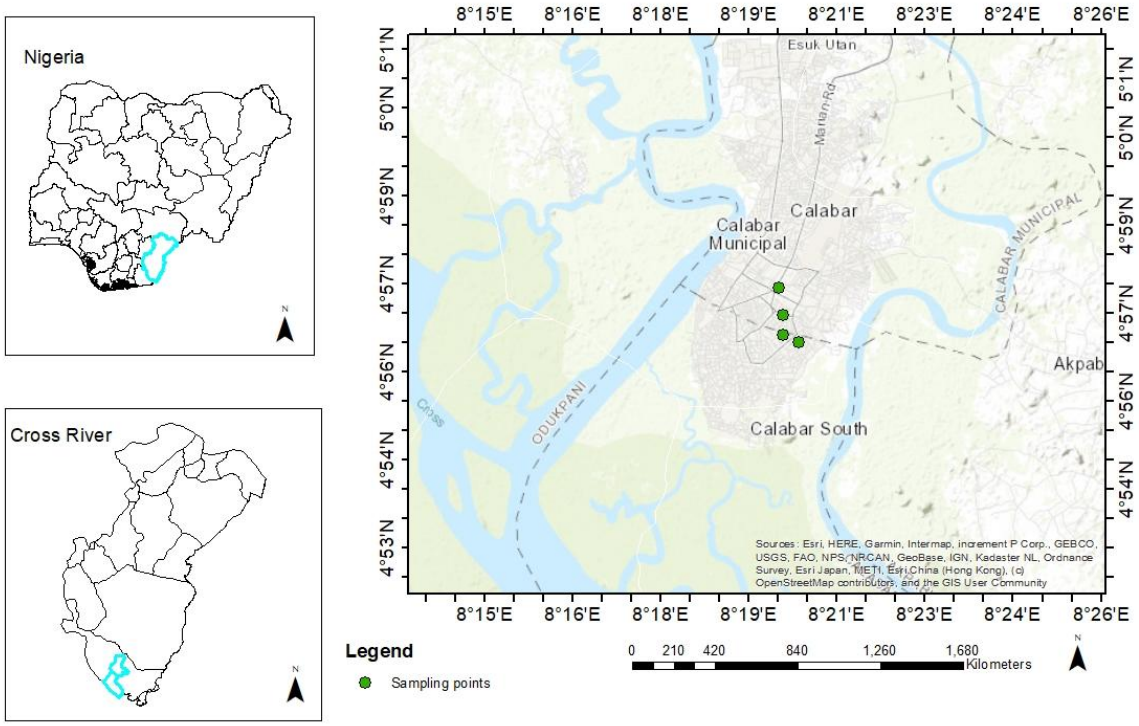

Figure 1. Map of Cross River state illustrating the designated sampling locations in Calabar Municipality.

Wet mount method

In the direct wet mount technique, approximately 2mg of fresh stool samples were placed on a microscope slide using a wooden applicator stick. For diarrheic and semi-solid samples, the stool was mixed with a drop of 0.85% physiological saline, while iodine was utilised for emulsifying formed stool samples. A coverslip was then applied, and the preparation was examined microscopically, initially with the 10× objective lens followed by the 40× objective lens (Demeke *et al* 2021). The motile forms of protozoan parasites were detected through the direct wet mount method, whereas cysts were identified using the Formol-Ether Concentration Technique.

Formol-ether concentration method

A 1g sample of stool was transferred into a clean conical centrifuge tube containing 7ml of 10% formol water. The mixture was then filtered through a sieve into a 15ml conical centrifuge tube. Following this, 4ml of diethyl ether was added to the formalin solution, and the contents were centrifuged at 300rpm for 1 minute. The supernatant was discarded, and a smear was prepared from the sediment using a microscope slide. The smear was subsequently examined under a microscope, first using a 10× objective lens, followed by a 40× objective lens (Demeke *et al* 2021).

Kata-Katz stool examination

Within two hours of sample collection, three thick Kato-Katz smears were prepared directly at the collection site, with all smears examined on the same day (Katz *et al* 1972). A spatula was employed to transfer a portion of the stool onto tissue paper. The sample was then covered with a screen, allowing it to pass through gauze and collect above it. The sieved material was scraped off using the spatula, and approximately 41.7mg of the sample was placed into a 6mm hole on a 1.5mm thick template on a microscope slide (WHO 2019). After carefully removing the template, the stool sample remained on the slide. A pre-soaked cellophane strip was placed over the stool, and the slide was inverted, pressing it firmly on a smooth, hard surface. The slide was then positioned with the cellophane side up to promote evaporation of water while glycerol cleared the faecal matter. The prepared Kato-Katz slides were examined under a light microscope for the presence of soil-transmitted helminth (STH) eggs or larvae.

Data analysis

Data collected were first input into an excel spreadsheet, processed to ensure accuracy, and then transferred to STATA software, version 14 (StataCorp LLC, Texas, USA), for further analysis. Descriptive statistics were utilised to summarise the socio-demographic characteristics of the participants. Chi-square was applied to assess the relationships between independent variables and the outcome variable. A binomial logistic regression model was used to identify potential predictors of Intestinal Parasitic Infections (IPIs). The strength of these associations was presented as odds

ratios (OR) with 95% confidence intervals. Statistical significance was set at p ≤0.05.

Results

A total of 260 participants were recruited for the study, with majority being female (51.5%, n=134). The mean age of the participants was 9.8 years (±3.83 SD), with ages ranging from 3 to 17 years. The largest proportion of participants were in the >10 years age group (44.6%, n=116). Most of the participants were from IJOH (25.4%) (Table 1).

The prevalence of IPIs across the demographic variables is shown in Figure 2. By sex, females (24.6%) [n = 33; 95% CI 18.1-32.5%] exhibited a slightly higher prevalence of IPIs than males (22.2%) [n = 28; 95% CI 15.8-30.2%] (p=0.65). The prevalence of IPIs varied significantly according to age-groups with participants aged 5-7 years recording the lowest prevalence (10.8%) [n=10; 95% CI 5.9-18.6%], while the highest prevalence was recorded among participants older than 10 years (33.6%) [n=39; 95% CI 25.6-42.6%] (P=0.001). Analysis by orphanage showed that the highest prevalence was recorded in MSWMBH (32.3%) [n=20; 95% CI 21.9-44.6%], followed by IJOH (27.3%) [n=18; 95% CI 18.0-39.0%]. In contrast, lower prevalence values were observed in BHFOH (17.2%) [n=11; 95% CI 9.8-28.2%] and ROH (17.7%) [n = 12; 95% CI 10.3-28.3%] (p=0.12).

Table 1: Socio-demographic characteristics of the study participants in Calabar.

Characteristic	Number	Percentage (%)
Gender		
Male	126	48.5
Female	134	51.5
Age-group (Years)		
5-7 years	93	35.8
8-10 years	51	19.6
>10 years	116	44.6
Orphanage		
MSWMBH	62	23.9
IJOH	66	25.4
BHFOH	64	24.6
ROH	68	26.2

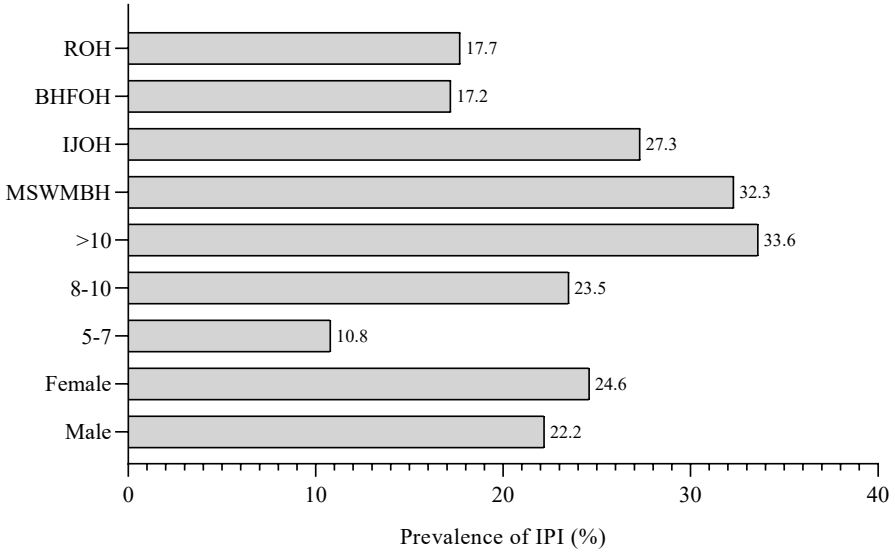

Figure 2. Distribution of intestinal parasites among study participants in Calabar

Ascaris lumbricoides was the most prevalent parasite found in 11.5% (n=30) [95% CI 10.10-12.90%] of the study participants. This was followed by hookworm infection recorded in 6.5% (n=17) [95% CI 5.71-7.29%] of the study participants. *Entamoeba histolytica*, *Enterobius vermicularis*, *Giardia lamblia*, *Strongyloides stercoralis*, and *Trichuris trichiura* were detected in 3.5% (n=20) [95% CI 3.07-3.93%], 2.7% (n=7) [95% CI 2.37-3.03%], 1.5% (n=4) [95% CI 1.32-1.68%], 1.5% (n = 4) [95% CI 1.32-1.68%], and 1.2% (n=3) [95% CI 1.06-1.35%] of the participants, respectively (Figure 3).

Various hygiene-related factors and their association with IPIs are presented in Table 2. The displayed prevalence of infection varied across different behaviours. Those who reported never having had an intestinal parasitic infection had a slightly higher infection rate (24%) than those who had experienced one before (20%), though this difference was not statistically significant (OR=1.27, 95% CI: 0.63-2.56, p=0.51). Individuals uncertain about their previous IPIs exhibited increased odds of contracting IPIs (OR=1.54, 95% CI: 0.56-3.77, p=0.46). Treatment history was not significantly associated with IPIs. Those uncertain about treatment had a higher, though not significant odds of infection rate (OR=3.53, 95% CI: 0.96-12.75, p = 0.11).

The use of footwear did not show a strong protective effect, with similar infection rates among those who wore footwear regularly (23.3%) and those who did so sparingly or not at all (24.8%). Although, those who used footwear sparingly or not at all had a higher odd of contracting IPIs (OR=1.13, 95% CI: 0.62-1.98, p=0.69) compared to those who wore shoes regularly. Handwashing habits showed a significant association with infection risk. Participants who did not wash hands

before eating were over four times more likely to have IPIs than those who did (OR=4.53, 95% CI: 2.41-8.24, p < 0.0001). Similarly, those who did not wash hands after toilet use had nearly five times higher odds of contracting IPIs (OR=4.96, 95% CI: 2.62-9.61, p<0.0001). Defaecation practices had some influence, with those defecating around (35.7%) or outside (30.4%) the compound showing higher infection rates than those using a latrine/toilet, though the associations were not statistically significant.

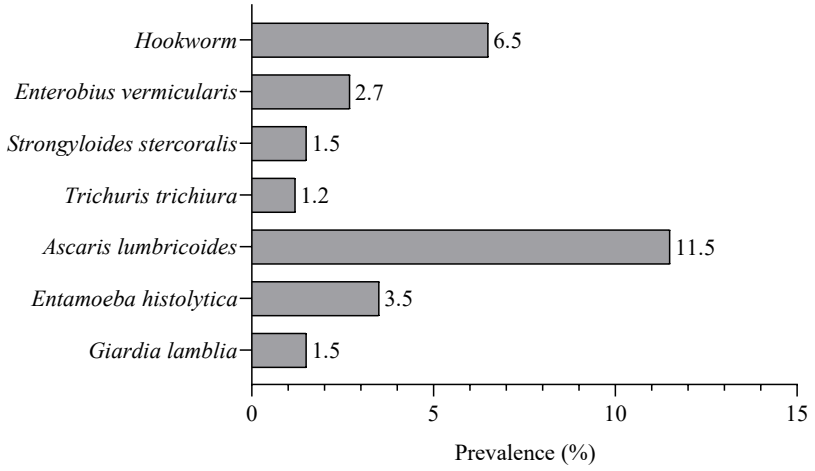

Figure 3. Prevalence of intestinal parasites among study participants in Calabar

Table 2: Factors Associated with intestinal parasitic infections among study participants in Calabar (n=260)

	Number examined (%)	No. positive (%)	No. negative (%)	OR (95% CI)	*P* value
Have you ever been infected with intestinal parasites?					
Yes	70 (26.9)	14 (20.0)	56 (80.0)	Reference	
No	154 (59.2)	37 (24.0)	117 (76.0)	1.265 (0.63-2.56)	0.505
Do not Know	36 (13.9)	10 (27.8)	26 (72.2)	1.538 (0.56-3.77)	0.462
Received treatment					
Yes	77 (29.6)	17 (22.1)	60 (77.9)	Reference	
No	173 (66.5)	39 (22.5)	134 (77.5)	1.027 (0.55-1.98)	0.935
Do not Know	10 (3.9)	5 (50.0)	5 (50.0)	3.529 (0.96-12.75)	0.113
Use of footwear					
Regularly	155 (59.6)	35 (22.3)	120 (77.4)	Reference	
Sparingly/not at all	105 (40.4)	26 (24.8)	79 (75.2)	1.128 (0.62-1.98)	0.683
Do you wash your hands before eating					
Yes	189 (72.7)	29 (15.3)	160 (84.7)	Reference	
No	71 (27.3)	32 (45.1)	39 (54.9)	4.527 (2.41-8.24)	<0.0001
Do you wash your hands after using the toilet					
Yes	143 (55.0)	16 (11.2)	127 (88.8)	Reference	
No	117 (45.0)	45 (38.5)	72 (61.5)	4.961(2.62-9.61)	<0.0001
When you are at home, where do you usually go to defecate?					
latrine/toilet	219 (84.2)	49 (22.4)	170 (77.6)	Reference	
Around compound	14 (5.4)	5 (35.7)	9 (64.3)	1.927 (0.69-5.88)	0.251
Outside compound	23 (8.9)	7 (30.4)	16 (69.6)	1.518 (0.59-3.89)	0.435
Do not know	4 (1.5)	-	4 (100.0)	-	-
Is there a place at home for you to wash your hands after defecation?					
Yes	41 (15.8)	12 (29.3)	29 (70.7)	Reference	
No	214 (82.3)	49 (22.9)	165 (77.1)	0.717 (0.34-1.50)	0.424
Do not know	5 (1.9)	-	5 (100.0)	-	-

Table 3: Description of the hygiene condition indicators in the study locations

Variables	MSWMBH	IJOH	BHFOH	ROH
Condition of water supply	Not consistent	Not consistent	Not consistent	Not consistent
Type of toilet facility	Water cistern	Water cistern	Water cistern	Water cistern
Number of toilets	1	1	2	2
Adequacy of toilet facility	Not Adequate	Adequate	Not Adequate	Adequate
Usage of toilet	In use	In use	Not always	Not always
Soap for hand washing after defecation	Absent	Absent	Absent	Absent
Is there tissue paper or water at home for use after defaecation?	Absent	Present	Present	Absent
Garbage around the surrounding	Present	Present	Present	Present

The availability of a handwashing facility at home did not significantly affect infection rates (p=0.42).

The assessment of the four orphanage homes revealed inconsistency in the condition of water supply. Each orphanage was equipped with water cistern toilets, but the number of toilets varied, with the MSWMBH and IJOH having one each, while BHFOH and ROH had only two. Toilet was inadequate in MSWMBH and BHFOH but satisfactory in IJOH and ROH, where toilet usage was also inconsistent. Notably, none of the orphanages provided soap for hand washing after defaecation. While tissue paper or water was available for use after defaecation in IJOH and BHFOH, it was absent in MSWMBH and ROH. Additionally, garbage was present in the surroundings of all the orphanages, highlighting potential sanitation concerns.

Discussion

The study examined the prevalence of IPIs among some orphanage residents in Calabar, revealing a higher infection rate among female and individuals aged 10 years and above. Among the orphanages assessed, MSWMBH recorded the highest prevalence, while *Ascaris lumbricoides* was the most occurring parasite. Participants who failed to wash their hands before meals and after using the toilet had a greater risk of IPIs compared to those who maintained proper hygiene. Alarmingly, none of the orphanages provided soap for hand washing after defaecation, and all had garbage in their surroundings, highlighting poor sanitation conditions.

The overall prevalence of 23.5% for IPIs recorded among orphanage residents in Calabar, Nigeria in the present study is lower than 39.1% reported by Omojo *et al* (2024) and the 63.16% documented by Anumba *et al* (2016) in Anambra State. However, the overall prevalence recorded in this study is higher than the 9.2% recorded by Hadiza *et al* (2019) in Kaduna State. Although this finding varies from previous studies, it highlights the significant public health risks faced by this vulnerable population. Institutionalised populations are often excluded from MAM and other control programmes, which primarily focus on school-aged children in formal educational settings (Arega *et al* 2020). The lack of routine deworming and preventive interventions leaves them susceptible to persistent infections, contributing to continuous transmission within their communities and impeding broader efforts to reduce disease prevalence.

The prevalence of IPIs was comparable between male and female, though slightly higher among female. Similar findings were reported by Rai *et al* (2017) and Gautam *et al* (2024) in Nepal, who attributed the higher prevalence in females to cultural roles that involve frequent contact with soil, such as household chores and agricultural activities. However, separate studies conducted in Malaysia (Choy *et al* 2014) and in Pakistan (Ulhaq *et al* 2021) found a lower prevalence of IPI infections in females compared to males. Furthermore, in this study, the prevalence of IPIs was significantly higher among individuals aged 10 years and above. This pattern aligns with findings from Ulhaq *et al* (2021) in Pakistan and Yeshiwas and Yohannes (2024) in Ethiopia. The increased risk in this age group may be influenced by greater exposure to contaminated soil and water due to physical activities, close peer interactions, overcrowding in institutionalized settings, and inadequate personal hygiene practices. These factors likely contribute to higher faeco–oral and skin-penetrating parasite transmission.

MSWMBH exhibited the highest prevalence of IPIs, whereas BHFOH recorded the lowest. An evaluation of the four orphanage homes showed that MSWMBH had just one functional toilet for the children, which was inadequate for the number of residents. It has been noted that overcrowding in toilet use fosters unsanitary conditions, facilitating the transmission of parasites such as *Ascaris lumbricoides*, *Giardia lamblia*, and *Entamoeba histolytica* through faecal contamination of hands, surfaces, and food (Kamau *et al* 2012). Furthermore, the high demand for limited toilet facilities, combined with the lack of soap for hand washing, often results in inadequate hygiene practices. This increases the likelihood of parasite transmission as children may leave the toilet without properly washing their hands. Restricted access to hand washing facilities further exacerbates the problem. Additionally, all orphanages had garbage present in their surroundings, raising sanitation concerns. Such conditions contribute to the contamination of water sources, soil, and shared surfaces, thereby increasing exposure to soil-transmitted helminths and other intestinal parasites. *Ascaris lumbricoides* was the most prevalent intestinal parasite among the study participants. This infection is a global

concern, particularly in tropical and subtropical regions where environmental conditions favour its transmission (Sitotaw and Shiferaw 2020). The high prevalence of *A. lumbricoides* in orphanage homes recorded in this study may be linked to multiple risk factors. The warm, humid surroundings, and shaded soil provides an ideal environment for the parasite to thrive. Additionally, a considerable number of participants did not practice proper handwashing before meals or after using the toilet, behaviours known to increase the risk of intestinal parasite infections (Wondimagegn and Hailu 2024).

Hookworm infection, the second most prevalent intestinal parasite reported in this study, remains a significant global health concern, with higher prevalence reported in low-income countries (Fenwick 2012). Previous studies have also documented its occurrence among residents of orphanage homes (Hadiza *et al* 2019). In this study, approximately 40% of participants reported rarely or never wearing footwear. Walking barefoot in warm climates, along with inadequate personal hygiene and poor environmental sanitation, have been reported to be key risk factors contributing to hookworm infection (Ghodeif and Jain 2023).

Intestinal protozoan parasites among the participants were identified, with *Entamoeba histolytica* being the most prevalent, followed by *Giardia lamblia*. Similar findings have been reported in studies involving children (Gebretsadik *et al* 2018; Subhan *et al* 2023; Usip *et al* 2023; Osman *et al* 2024). *Entamoeba histolytica* has also been documented as the most common intestinal protozoan parasite in studies conducted in other regions (Mbae *et al* 2013; Mulatu *et al* 2015; Gebretsadik *et al* 2018; Wasihun *et al* 2020). Intestinal protozoan infections are a leading cause of illness in children, primarily transmitted through the ingestion of cysts via the faeco-oral route, either through direct person-to-person contact or contamination of food and surface water (Zemene and Shiferaw 2018).

Hand washing practices were significantly associated with the risk of IPIs. Participants who did not wash their hands before eating were more than four times as likely to be infected compared to those who did. Similarly, individuals who neglected hand washing after using the toilet had nearly five times higher odds of contracting an infection. Studies have shown that children with poor hand hygiene are particularly susceptible to parasitic infections (Zemene and Shiferaw, 2018), which likely contributed to the range of intestinal parasites observed in this study.

Conclusion

The overall prevalence of IPIs among the children was 23.5%. *Ascaris lumbricoides* was the most common helminth, followed by hookworm, while *Entamoeba histolytica* was the predominant intestinal protozoan. Children aged 10 years and above, as well as those who did not practice proper hand washing before meals and after using the toilet, were more vulnerable to IPIs compared to those with better hygiene habits. To lower infection rates, both children in institutional homes and their guardians or caregivers should be provided with health education on preventing IPIs. Additionally, control programmes should prioritise this often-overlooked population, as they may serve as reservoirs for intestinal parasitic infections.

Conflict of interest

The authors declare no conflict of interest.

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