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Prevalence and Pattern of Intestinal Parasitic Infestations among HIV Infected Children in Lagos, Nigeria

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Abstract

Introduction: Intestinal parasitic infections significantly affect paediatric population globally with over 800 million children at risk. The chronic nature of these infestations is associated with chronic disabilities approaching 9 million Disability Adjusted Life Years (DALYs). Co-infection of Human Immunodeficiency Virus (HIV) and intestinal parasitic infections adorned the pre-Highly Active Antiretroviral Therapy (HAART) era resulting in impaired nutritional state and dysfunctional immune system, especially amongst affected children. The success of HAART in conjunction with other life-saving measures has improved the outcome of children living with HIV. This study aimed to evaluate the prevalence and pattern of parasitic infections among children living with HIV in Lagos. **Methodology:** Consecutive children attending the paediatric anti-retroviral clinic were enrolled. Socio-demographic and clinical characteristics elicited from the clinical examination were recorded. Fresh stool samples of the children were obtained and examined for intestinal parasites. Data were analyzed with the Statistics Package for Social Sciences (SPSS) 20 software. **Results:** A total of 102 children participated in the study with a majority being males (52.9%), in primary school (73.5%) and living in urban settings (82.4%). Six children were found to harbour intestinal parasites giving a prevalence of 5.9% with *Ascaris lumbricoides* (50%) and *Entamoeba histolytica* (33.3%) being the prevalent parasites seen. Children with a Body Mass Index (BMI) Z-score < −1 had higher estimates of intestinal parasitic infestations [p value < 0.05, OR 10.27, CI 1.72 - 61.20]. **Conclusion:** The prevalence of intestinal infestation was 5.9% with Ascariasis being the commonest intestinal parasitosis in our study. Malnutrition was found to be significantly associated with its occurrence.

Keywords

Intestinal, Parasitic, Infections, Infestations, Paediatric HIV, Lagos

1. Introduction

Sub Saharan Africa [SSA] remains the epicentre of communicable diseases with a significant detrimental impact on health indices of its populace. SSA accounts for about 88% of the global burden of children and adolescents living with HIV as of 2019 [1]. Approximately 1.5 billion people are infected with Soil-Transmitted Helminths globally and children are most affected. Over 267 million preschool-age children and over 568 million school-age children live in areas where these parasites are intensively transmitted and require treatment and preventive interventions [2]. Several measures have been instituted to reduce the scourge of HIV/AIDS and parasitic infection (helminths and protozoa).

Parasitic infections significantly affect the paediatric population with reported higher prevalence among children living with HIV [3] [4] [5]. These parasitic infections are associated with chronic disabilities of approximately 9.0 million Disability Adjusted Life Years (DALYs) yearly; consequently, increasing morbidity and mortality [6] [7]. The chronic disability caused by the infections has a negative impact on childhood growth, neurocognitive development, and vital organs (gastrointestinal system, hepatobiliary nervous system, and the genitourinary system) functions.

Parasitic infections among children living with HIV have devastating outcomes due to impaired nutritional state and overall dysfunctional immune system. Several works before the Highly Active Antiretroviral Therapy (HAART) era reported varied parasitic organisms among children living with HIV ranging from roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*), hookworm (*Necator americanus* and *Ancylostoma duodenale*), *Giardia lambdia* and *Cryptosporidium* spp., with a significant high disease burden compared to non-HIV infected children [2].

The improved availability and accessibility of HAART have continued to improve the horizons of HIV/AIDS infections [8]. The positive impact of HAART and the several ongoing measures by the government towards combating parasitic infections in the population could result in a significant reduction in the burden of parasitic infestations and better health status of children living with HIV [2] [8] [9]. This study evaluated the prevalence and pattern of parasitic infections among children living with HIV placed on HAART in a large treatment centre in Lagos, Nigeria.

2. Methodology

This study was conducted at the Paediatric outpatient clinic, Nigerian Institute of Medical Research (NIMR), Yaba, Lagos. A large HIV care and treatment centre in Lagos, Nigeria with 250 active paediatric cases that are provided with care and treatment. This clinic implements the Federal Government of Nigeria anti-retroviral (ARV) access programme with support from implementing partners.

The study population include children living with HIV on HAART who presented at the centre for care and management.

Inclusion criteria: HAART-experienced HIV positive children, whose guardians were able to understand and give informed consent.

Study design: A cross-sectional study of purposively selected 200 participants was conducted. However, only 102 consented to participate in the study.

Sample and Data Collection: A Pretested structured questionnaire developed by the team was used to elicit responses from participants and their guardians. This was administered by trained research assistants. The questionnaire assessed the socio-demographic characteristics and risk factors for these infections.

Stool samples were collected and examined for the presence of intestinal protozoa and helminths. An investigation into intestinal parasitic protozoal and helminths was carried out by stool analysis using microscopy (wet preparation for motile trophozoite and larva of parasites, followed by concentration method). Haemoglobin level, CD4 counts and viral load of each participant were extracted from the patient's clinic folder to evaluate its association with laboratory findings.

2.1. Laboratory Procedures

Stool collection and processing: A single fresh stool sample was collected into a sterile universal container. A portion of the stool was preserved in 10% formalin in a proportion of 10 g of stool in 3 ml of formalin. The stool was examined by wet preparation (for motile trophozoites and larval stages) and concentration method to increase the sensitivity of the assay.

2.2. Data Analysis

Data were collated, entered and analysed using statistical package for social sciences (SPSS) version 20. Descriptive statistics were performed on the demographic data (age, sex, occupation, ethnic group, religion). Data were summarized using frequency tables and pie charts. Categorical risk factors for intestinal helminths were analyzed, and the strength of association measured using the chi-square test (X^2 test) and its associated P-value. Values were considered to be statistically significant when the p-value obtained was less or equal to 0.05.

Ethical approval: NIMR Institutional Review Board (IRB) approved the study. Informed assent/consent was sought from the study participants before enrolment into the study.

3. Results

3.1. Socio-Demographic Characteristics

A total of 102 respondents were enrolled in the study. The age ranged from one year to 14 years with a mean of 8.0 (±3.1) years. Most of the participants were males (52.9%), and in primary school (73.5%). Majority of mothers and households had at least secondary school education (77.9%) and a monthly income of at most fifty thousand naira (77.2%) respectively. Most participants (82.4%) lived in urban parts of Lagos.

Six of the 102 participants had ova of different intestinal parasites in their stool samples, giving a 5.9% prevalence of intestinal parasitic infection among HIV infected children on antiretroviral therapy. The most prevalent parasite was *Ascaris lumbricoides* (50%), followed by *Entamoeba histolytica* (33.3%). *Giardia intestinalis* (16.6%) and *Dicrocoelum dendriticum* (16.6%). There was dual infection with *Ascaris lumbricoides and Dicrocoelum dendriticum* in 16.6% of infected participants. **Figure 1** depicts the pattern of intestinal parasite infection among participants. There were no statistically significant differences in the sociodemographic characteristics of infected and non-infected participants as detailed in **Table 1**.

3.2. Clinical and Laboratory Characteristics

Majority of participants had haemoglobin levels of ≥11 g/dL, a CD4 count of ≥500 cells/μL, and were virally suppressed with HIV RNA viral loads < 50 copies/mL. There were no statistically significant differences in the level of haemoglobin, CD4 counts or viral suppression rates among infected and non-infected participants.

Children with intestinal parasitic infection had a lower mean BMI Z score (−1.33) than the uninfected (−0.57). A significantly higher proportion of the infected children was malnourished with a BMI Z score less than −0.1. Infected participants also had a lower mean duration on antiretroviral therapy than the uninfected [49.5 (±31.1) versus 62.0 (±35.3)] but this was not statistically significant. One-third of infected [2] and about 15% of uninfected children [10] were

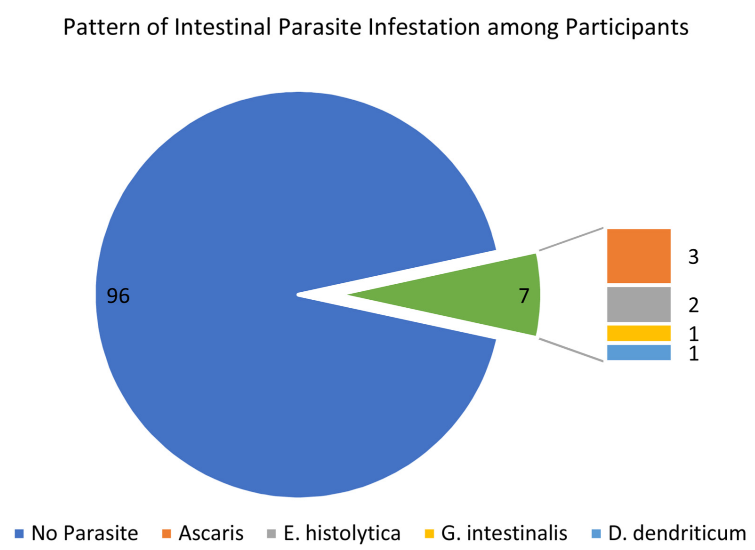

Figure 1. Pattern of intestinal parasite infestation among participants.

Table 1. Socio-demographic characteristics of study participants.

Characteristic	Infected n (%)	Not Infected n (%)	OR (95% CI)	P-value
Age (years):				0.13
Mean (±SD)	6.2 (±2.1)	8.2 (±3.1)		
Sex:				
Male	4 (66.7)	50 (52.1)	1.84 (0.32-10.52)	0.487
Female	2 (33.3)	46 (47.9)		
Maternal Education				
<Secondary School	1 (16.7)	20 (22.5)	0.69 (0.08 - 6.25)	0.740
≥Secondary School	5 (83.3)	69 (77.5)		
Household Income:				
<N50,000	5 (83.3)	66 (77.1)	1.52	0.710
≥N50,000	1 (16.7)	20 (22.9)	(0.18 - 13.73)	
Residence:				
Urban	5 (83.3)	79 (82.3)	1.08 (0.12 - 9.81)	0.948
Semi-Urban	1 (16.7)	17 (17.7)		

not dewormed six months prior to the study. Table 2 details the clinical and laboratory characteristics of infected and uninfected participants.

3.3. Water and Sanitation and Hygiene Characteristics

The water, sanitation, and hygiene characteristics of participants are shown in Table 3. The major source of water supply was sachet water and borehole for the infected and non-infected participants. Other sources of water included tap water and bottled water (33.3% versus 8.9%, and 0.0% versus 5.4% respectively). A significantly higher proportion of children with intestinal parasite infection washed their hands with only water and no soap before eating. These infected children were also significantly less likely to wash their hands after using the toilet than the uninfected children. Table 3 depicts the WASH characteristics of study participants.

4. Discussion

HIV/AIDS and Intestinal parasitic infestation remains a public health issue in sub-Saharan Africa. However, the ease of availability and accessibility of HAART has reduced the associated opportunistic infection including entero-parasitic infection and overall mortality [11]. This current study describes the pattern of parasitic infestation among children living with HIV on HAART. In this study, the prevalence of parasitic infestation was 5.9%. The distribution of entero-parasitic organisms were *Ascaris lumbricoides* (50%), *Entamoeba histolytica* (33.3%), *Giardia intestinalis*, and *Dicrocoelium dendriticum* (16.6%) respectively. 16.6% had dual infestation with *Ascaris lumbricoides* and *Dicrocoelium dendriticum*. HIV infected children with intestinal parasite infestation were significantly malnourished compared to those non-infested.

Table 2. Clinical and laboratory characteristics of participants by worm infestation.

Characteristic	Infected n (%)	Not Infected n (%)	OR (95% CI)	P-value
BMI/Weight for Age Z score:				
Mean (±SD)	−1.33 (1.2)	−0.57 (0.9)		0.07
BMI Z score:				
<−1	4 (66.7)	15 (16.3)	10.27	**0.002**
≥−1	2 (33.3)	77 (83.7)	[1.72 - 61.20]	
Type of HAART:				
1st Line	5 (83.3)	83 (86.5)	0.78 (0.08 - 7.25)	0.82
2nd Line	1 (16.7)	13 (13.5)		
Duration on ART (months)				
Mean (±SD)	49.5 (31.1)	62.0 (35.3)		0.34
Dewormed in Last 6 months				
No	2 (33.3)	13 (13.5)	3.19 (0.53 - 19.22)	0.18
Yes	4 (66.7)	83 (86.5)		
Hb (g/dL):				
• <11.0	1 (16.7)	36 (40.0)	0.3	0.256
• ≥11.0	5 (83.3)	54 (60.0)	[0.03 - 2.68]	
CD4 (cells/μL):				
• <500	1 (16.7)	6 (6.6)	2.83	0.356
• ≥500	5 (83.3)	85 (93.4)	[0.28 - 28.29]	
VL (copies/mL):				
• <50	5 (83.3)	61 (69.3)	2.21	0.467
• ≥50	1 (16.7)	27 (30.1)	[0.25 - 19.86]	

Table 3. WASH practices of participants.

Characteristic	Infected n (%)	Not Infected n (%)	OR [95% CI]	P-value
Water Supply:				
• Sachet Water	3 (50.0)	55 (59.8)	1.31	0.819
• Borehole	1 (16.6)	24 (26.1)	(0.13 - 13.23)	
Hand Wash Before Eating				
• Water Only	5 (83.3)	27 (28.1)	12.8 (1.4-114)	**0.004**
• Water and Soap	1 (16.7)	69 (71.9)		
Hand Wash After Toilet:				
• No	1 (16.7)	1 (1.1)	9.9	**0.008**
• Yes	5 (83.3)	94 (98.9)	(1.4 - 50.43)	
Wash Fruit:				
• Yes	4 (100.0)	94 (100.0)		
• No	0 (0.0)	0 (0.0)		

This low prevalence (5.9%) could allude to the urban-dwelling settings for a majority of the study participants in addition to the availability of potable water supply, appropriate waste/sewage disposal systems, and the use of HAART among our study participants. However, we could not compare with HAART naïve HIV infected children and uninfected children which is a limitation of the study. Nonetheless, our finding is comparable to 5.3% reported by Akinbo *et al.* in Benin City, and 3.9% - 6.2% among non-HIV infected children in Nigeria [11] [12]. The similarity in the prevalence could be alluded to the study site being hospital based in addition to the urban status of both study sites where basic infrastructure (water, waste/sewage disposal system) are readily available. However, this finding is at variance with 15.2% by Yiltok *et al.* in Jos, 14.4% reported by Akinbo *et al.* in Kogi, North Central Nigeria, 27.8% by Mengist *et al.* in Ethiopia, and 24% by Bachur *et al.* in Brazil among HAART exposed children living with HIV [5] [10] [11] [13]. Furthermore, the prevalence of 5.9% is also at disparity with a meta-analysis report of the pooled prevalence estimate of 54.8% among Nigerian children [14]. The disparity affirms the variability in entero-parasitic infection across different geographic locations.

The organisms isolated in this study agree with studies on intestinal parasites commonly seen in HIV-infected patients [4] [5] [11]-[16]. There exist variations in the specific organism prevalence in the different studies; thus, affirms the variation in the distribution of the parasite in different geographical settings.

The prevalence of *Ascaris lumbricoides* in the current study is 50%. This is because it is one of the most common helminthic infectious agents worldwide with the highest prevalence in the tropics and subtropical regions. The prevalence in this study was comparable to the reported predominance of *Ascaris lumbricoides* among children in urban and rural settings in Nigeria [5] [14] [17] [18] [19]. This pattern is in consonance to previous works among HIV infected patients in Jos, Benin City, Abeokuta, and in children across Nigeria [5] [12] [14] [20]. This organism was the second most prevalent organism in Ilorin Nigeria, and Ethiopia among HIV infected patients on HAART [4] [13].

Entamoeba histolytica with a prevalence of 33% and *Giardia intestinalis* as the first and second most prevalent intestinal protozoa in our study is in concordance with several reports on the pattern of protozoal infection in studies involving children living with HIV [7] [8] [9] [11] and non-HIV-infected children [17] [18] [19] [21].

In the present study, the prevalence of polyparasitism was 16.6%. The co-infecting agents were *Dicrocoelium dendriticum* and *Ascaris lumbricoides*. This co-infection was seen in a 2-year-old male child who was diagnosed with the co-infection at 25th month of age. *Dicrocoelium dendriticum* is a trematode; a zoonotic infection that rarely infests humans with a predilection for the liver; thus, called a liver fluke. The organism infests predominantly ants, land snails, rabbits, goats, sheep, and cattle with distribution in North America, Africa, and Asia. Human infestation is usually sporadic and through the ingestion of infected ants found in herbs, raw fruits, vegetables, or drinking water [20] [21]. Previous work reported the case in detail [22].

The significant association between children living with HIV infested with enteroparasitic organisms and malnutrition in the present study affirms the long-established interaction between intestinal parasites and nutritional malabsorption, increased metabolic rate, loss of appetite and diarrhoea. In addition, HIV infection results in a further negative impact on the nutritional status and the general health status of affected persons. This is in concordance with previous studies by [23] [24] [25]. However, contrary to finding in some other studies [18] [19].

There was no significant association between the haemoglobin levels and infestation with parasitic organisms. This is similar to findings by Mengist *et al.* in Ethiopia [13]. This could be due to the long duration of ART in this study. This finding is at variance with earlier reports in the adult population in Nigeria [15]. The variation could be due to the short duration of ART [3 - 6 months] and the older age in the previous study.

5. Conclusion

The prevalence of intestinal parasites among children living with HIV on HAART in our centre was low. *Ascaris lumbriciodes and Entamoeba histolytica* were the most common helminth and protozoa identified. Malnutrition was significantly associated with intestinal parasitosis in our study.

Limitation of the Study

Data to show HAART naïve HIV infected children and uninfected children was not available.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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