doi: 10.5216/rpt.v53i2.79009

ORIGINAL ARTICLE

INTESTINAL PARASITIC INFECTIONS IN PATIENTS WITH AIDS IN NORTHEAST BRAZIL: AN HISTORICAL SERIES FROM 2017 TO 2022

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ABSTRACT

Opportunistic infections are a major cause of death in patients with acquired immunodeficiency syndrome (AIDS). Intestinal parasitic infections (IPIs) may aggravate the clinical condition of immunosuppressed patients and they may increase the risk of death. The goal of the present study was to determine the epidemiological profile of patients with AIDS and IPIs who visited a reference hospital for contagious diseases in Northeast Brazil from 2017 through 2022. It was an observational, transverse, descriptive, and analytical study. Medical records were assessed, epidemiological questionnaires were administered to identify risk factors for IPI, and coproparasitological examinations were performed to detect IPI. Of the 248 patients included in this study, 30.6% (76/ 248) tested positive for IPI. *Entamoeba histolytica/ dispar* (16.5%) and *Strongyloides stercoralis* (14.4%) were the most prevalent protozoa and helminths identified. Diarrheic consistency was observed in 25.8% of the feces samples, and mucus or blood were present in 19.4%. Analysis of the sociodemographic profiles of patients with IPIs showed that most were female, lived in small cities, earned up to two minimum wages, had an incomplete primary education, and were single. We conclude that to control parasite transmission in patients with HIV/AIDS, public policies related to human and environmental health, routine coproparasitological exams, and acceptance of antiretroviral therapy are necessary.

KEY WORDS: Acquired immunodeficiency syndrome; opportunistic infections; intestinal parasite infections; public health.

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Received for publication: 11/4/2024. Reviewed: 20/6/2024. Accepted: 24/6/2024.

INTRODUCTION

Acquired immunodeficiency syndrome (AIDS) caused by HIV is an immunological systemic infection affecting mainly T $CD4^+$ lymphocytes. Immunodeficiency caused by HIV increases the risk of opportunistic infections, neoplastic diseases, and other comorbidities (Brasil, 2024). Intestinal parasitic infections (IPIs) are one type of opportunist infection that patients with AIDS are susceptible to (Eshetu et al., 2017). IPIs are considered neglected tropical diseases as they are closely related to public health and mainly occur in poorly developed countries with low rates of basic sanitization due to a lack of environmental hygiene, consumption of unfiltered water, precarious housing, low levels of formal education, and the existence of coinfections that facilitate infection with opportunistic parasites (Amare et al., 2015). HIV-positive patients with the risk factors mentioned above are more vulnerable than the general population (Nsagha et al., 2015; Barcelos et al., 2018).

Opportunistic infections may worsen clinical evolution and prognosis and are considered the leading cause of death in patients with AIDS (Alves et al., 2017). According to UNAIDS, in 2021, 38.4 million people worldwide were HIV positive. Parasitic infections in the general population result in 2-3 million deaths every year (Antunes et al., 2020). The severe impact of IPIs on immunosuppressed patients demands timely diagnosis, as these infections can lead to chronic diarrhea, weight loss, dehydration, and anemia (Silva, 2017). Coproparasitological examinations frequently identify parasites, which help guide appropriate treatment (Gebre et al., 2019). This study emphasizes the importance of coinfection with HIV and intestinal parasites, highlighting the importance of epidemiological studies to develop effective prevention measures through both public policies and direct interventions.

In Brazil, the northern and northeastern regions are endemic for IPIs, with a prevalence of > 50% (Crisostomo et al., 2021; Vilar et al., 2021). The goal of the present study was to determine the epidemiological profile of patients with AIDS and IPIs who visited a reference hospital for contagious diseases in Northeast Brazil from 2017 through 2022.

MATERIAL AND METHODS

This was an observational transverse, descriptive, and analytical study. Medical records were assessed, epidemiological questionnaires were administered to identify risk factors for IPI, and coproparasitological examinations were carried out in patients with AIDS who attended the School Hospital Dr. Hélvio Auto, located in the city of Maceió in the State

of Alagoas (AL), Northeast Brazil. The study was approved by the Ethics Committee of Alagoas Health Sciences State University (UNCISAL; protocol number CAAE:70057017.2.00005011).

The inclusion criteria were a positive diagnosis of AIDS and a hospitalization during the study period. Patients were excluded if they were discharged before obtaining a fecal sample, if they were bedridden and under psychiatric care without a companion, if they presented with intestinal constipation, if they did not know about their AIDS diagnosis, if they died, or if they were under isolation.

An epidemiological questionnaire was designed to obtain the following information: age, sex, address, marital status, monthly family wage, educational level, type and source of water consumed, destination of solid waste, digestive symptoms and eating habits, including locations where meals were consumed, consumption of raw fruits and vegetables, type of meat consumed, consumption of lightly cooked meat, and handwashing habits. After answering the questionnaire, a sterile fecal collector was given to the patient, and they were asked to provide a single sample the next day.

All samples were transported to the Laboratory of Parasitic and Infectious Diseases (LaDIP) and subjected to macro- and microscopic evaluations. Fecal consistency and the presence of mucus or blood were recorded. Then, the samples were processed using the Hoffman, Pons, and Janer (H. P. J.), Baermann Moraes, and modified Ziehl-Neelsen methods. Several diagnostic techniques have been used to increase the sensitivity of detecting different species of parasites, including *Strongyloides stercoralis*, and opportunistic protozoa, such as *Cryptosporidium* and *Cystoisospora*.

Data obtained from the questionnaires and medical records were organized in a spreadsheet and they were processed using Epi Info Software (version 7.25.0, CDC) to generate graphics. Differences were compared using Fisher's exact test with SPSS 25.0 statistical software. P values less than 0.05 were considered significant.

RESULTS

Of the 574 patients initially enrolled in this study, 233 were included in the analysis. The reasons for exclusion are listed in Table 1. Hospital discharge before fecal sample collection was the main reason for exclusion (n= 124). One bedridden patient who died during the studied period was also excluded.

Table 1. Reasons for exclusion of patients with AIDS who attended a reference hospital for infectious diseases between 2017 and 2022 in the city of Maceió in the State of Alagoas, Brazil.

Reason	N	%
Hospital discharge	124	53.2
Bedridden patient without a companion	52	22.3
Intestinal constipation	38	16.3
Isolated patient	8	3.4
Psychiatric patient without a companion	5	2.1
Unknowledge that is HIV-positive	5	2.2
Death	1	0.5
Total	233	100

Of the 248 patients included, 76 (30.6%) had an IPI. The number of samples positive for protozoa was almost twice the number positive for helminths (Table 2). The most common protozoan in the fecal samples was *Entamoeba histolytica/ dispar* (16.5%), followed by *Endolimax nana* (13.4%). *S. stercoralis* (14.4%) and Hookworm (12.4%) were the most common helminths. Protozoans and helminths with lower frequencies were *Giardia intestinalis* (4.1%) and *Ascaris lumbricoides* (1.0%). Notably, the number of positive samples (n= 97) was higher than that of patients with positive samples (n= 76) because of polyparasitism.

According to the age group of hospitalized patients, we present the following results: < 18 years old 0.6%; 18-24 years old 4.8%; 25-29 years old 12.0%; 30-34 years old 10.2%; 35-39 years old 23.9%; 40-44 years old 12.0%; 45-49 years old 12.6; 50-54 years old 13.2%; 55-60 years old 7.8%; >60 years old 3.0%. Thus, it is observed that most patients were between 35 and 39 years of age, and few were younger than 18 years old or older than 60 years old.

Most fecal samples had a normal consistency (67.7%) and no blood or mucus (78.2%). However, the frequency of diarrhea was almost four times higher in patients with IPI ($p < 0.001$), and the presence of blood or mucus was eight times more frequent in patients with IPI than in patients without IPI ($p < 0.001$) (Table 3).

Table 2. Frequency of positive fecal samples from 248 patients with AIDS who attended a reference hospital for infectious diseases between 2017 and 2022 in the city of Maceió in the State of Alagoas, Brazil.

Parasite	Number of positive samples	%
Protozoa	63	65
Entamoeba histolytica/dispar	16	16.5
Endolimax nana	13	13.4
Cryptosporidium sp	12	12.4
Cystoisospora belli	6	6.2
Entamoeba coli	7	7.2
Iodamoeba butschlii	5	5.2
Giardia intestinalis	4	4.1
Helminths	34	35
Strongyloides stercoralis	14	14.4
Hookworm	12	12.4
Schistosoma mansoni	7	7.2
Ascaris lumbricoides	1	1.0
Total	97	100

Table 3. Macroscopic evaluation of positive and negative samples for intestinal parasitic infection from 248 patients with AIDS who attended a reference hospital for infectious diseases between 2017 and 2022 in the city of Maceió in the State of Alagoas, Brazil.

Variable		Positive samples		Negative samples		p value
	Classification	N	%	N	%	
Fecal consistency	Normal	12	4.8	156	62.9	< 0.001
	Diarrhea	64	25.8	16	6.5	
Presence of blood or mucus	Yes	48	19.4	6	2.4	< 0.001
	No	28	11.3	166	66.9	

Although most patients were male (65.3%), positive fecal samples were more frequent in females. Most patients with IPIs lived in cities other than Maceió (the state capital), earned up to two minimum monthly wages, had an incomplete basic education, and were single. Most patients with negative fecal samples were men who lived in Maceió, earned up to two minimum wages, had an incomplete primary education, and were single (Table 4).

Table 4. Sociodemographic profile from 248 patients with AIDS who attended a reference hospital for infectious diseases between 2017 and 2022 in the city of Maceió in the State of Alagoas, Brazil.

Variable		Positive samples		Negative samples		p value
	Categories	N	%	N	%	
Gender	Female	56	22.6	28	11.3	< 0.001
	Male	18	7.26	144	58	
	Other	2	0.8	0.00	0.0	
Origin	Maceió	7	2.8	126	50.8	< 0.001
	Other	69	27.8	46	18.5	
Monthly wage*	Up to 2	65	26.2	169	68.1	0.001
	2-4	7	2.8	2	0.8	
	4-6	4	1.6	1	0.4	
Educational level	No education	3	1.2	53	21.4	< 0.001
	Basic incomplete	22	8.9	114	46.0	
	Basic complete	0	0.0	0	0.0	
	Incomplete secondary school	16	6.4	0.00	0.0	
	Complete secondary school	19	7.7	3	1.2	
	Incomplete high school	8	3.2	1	0.4	
	Complete high school	8	3.2	1	0.4	
Marital status	Single	36	14.5	121	48.8	0.001
	Married	22	8.9	28	11.3	
	Divorced	12	4.8	20	8.1	
	Widow/er	6	2.4	3	1.2	

*minimum wage

As it can be seen in Table 5, most patients who had IPIs (confirmed with positive samples) ate meals at home (25.8%), drank unfiltered water (28.6%), ate raw fruits and vegetables (20.2%), did not wash their food (14.9%), consumed beef (28.6%), chicken (27.0%) and fish (16.1%), consumed well-cooked meat (29.8%), and lacked proper handwashing habits before eating (26.6%) and after using the bathroom (26.6%). Their water was sourced from artesian wells (21.0%), they used home sumps for solid waste (13.3%), and they had no gastrointestinal symptoms (26.6%).

For patients with negative fecal samples, most consumed meals at home (58.1%), drank filtered water (38.3%), ate raw fruits and vegetables (68.9%), used untreated water to wash food (31.8%), consumed beef (68.1%), chicken (68.1%), pig (44.8%), goat (45.6%), and fish (67.74%), ate well-cooked meat (56.8%), and practiced good handwashing habits before eating (51.2%) and after using the bathroom (59.3%). Their water was treated and supplied by public service (63.7%), they used home sumps for solid waste (41.5%), and they presented with gastrointestinal symptoms (60.1%). Except for the location where meals were eaten and beef consumption, all other evaluated variables influenced the diagnosis of IPI (Table 5).

Table 5. Clinical and epidemiological profile from 248 patients with AIDS who attended a reference hospital for infectious diseases between 2017 and 2022 in the city of Maceió in the State of Alagoas, Brazil.

Variable		Positive samples		Negative samples		P value
	Categories	N	%	N	%	
Local of meal	Home	64	25.80	144	58.06	0.543
	Out of home	12	4.84	28	11.29	
Drinking water	Filtered	5	02.01	95	38.31	< 0.001
	Boiled	0	0.00	5	02.02	
	Unfiltered	71	28.63	71	28.63	
	Other	0	0.00	1	0.40	
Ate raw fruits and vegetables	Yes	50	20.16	171	68.95	< 0.001
	No	26	10.48	1	0.40	

Fruits and vegetables washing	Filtered/ boiled water	3	1.21	16	6.45	< 0.001
	Untreated water	34	13.71	79	31.85	
	Water + vinegar/ bleach	2	0.80	70	28.22	
	Unwashed	37	14.92	7	2.82	
Consume beef	Yes	71	28.63	169	68.14	0.060
	No	5	02.02	3	1.21	
Consume pig	Yes	9	3.63	111	44.76	< 0.001
	No	67	27.02	61	24.60	
Consume goat	Yes	7	2.82	113	45.56	< 0.001
	No	69	27.82	59	23.79	
Consume chicken	Yes	67	27.02	169	68.14	0.002
	No	9	3.63	3	1.21	
Consume fish	Yes	40	16.13	168	67.74	< 0.001
	No	36	14.52	4	1.61	
Level of meat cooking	Raw	0	0.00	1	0.40	< 0.001
	Slightly cooked	2	0.80	29	11.69	
	Well cooked	74	29.84	141	56.85	
	Not applicable	0	0.00	1	0.40	
Handwashing habit	Yes	10	04.03	127	51.21	< 0.001
	No/ Sometimes	66	26.61	45	18.14	
Handwashing after bathroom	Yes	10	04.03	147	59.27	< 0.001
	No/ Sometimes	66	26.6	25	10.1	
Water supply	Public service	20	08.06	158	63.71	< 0.001
	Artesian Well	52	20.97	12	4.84	
	Rarely	4	1.61	1	0.40	
	Not applicable	0	0.00	1	0.40	

Solid waste destination	Sump	33	13.31	103	41.53	0.013
	Public management	30	12.09	56	22.58	
	Open area	12	4.84	12	4.84	
	Other	1	0.40	0	0.00	
	Not applicable	0	0.00	1	0.40	
Gastrointestinal symptoms	Yes	10	04.03	149	60.08	< 0.001
	No	66	26.61	23	9.27	

DISCUSSION

In this study, approximately 30% of the analyzed patients with AIDS had an IPI. This is similar to the frequency reported among 5,833 HIV/AIDS-positive patients in Ethiopia (39%) (Wondmieneh et al., 2020) and among 270 HIV-positive patients in central Brazil (28.9%) (Barcelos et al., 2018). These findings highlight the relationship between intestinal parasites and HIV, which may have prognostic implications.

In this study, *E. histolytica/díspar* was the most frequently detected protozoon, and *S. stercoralis* was the most commonly detected helminth species. Botero-Garcés et al. (2021) reported that *E. histolytica/ dispar* was among the most frequently diagnosed parasite in 204 HIV-positive patients. The diagnosis of *S. stercoralis* in the present study is relevant because of its potential to cause death in immunosuppressed patients due to hyperinfection with parasites in several organs, such as the lungs, liver, heart, and central nervous system. Hyperinfection negatively impacts the clinical status of the patient and it can even cause death when effective therapy is not applied (Torrez, 2019).

Most patients were 35–39 years of age, corroborating the findings of Catapan et al. (2022), who reported a higher prevalence of HIV positivity among patients 31–50 years of age. This age group includes productive, sexually active individuals, which leads to a higher potential for HIV infection and its complications. The higher prevalence of infections in this specific population would directly affect the productivity of any country due to labor interruption and public health expenses.

Patients with IPIs had a higher frequency of diarrheal feces, which is an important clinical association. Patients positive for IPIs also had a higher frequency of blood or mucus in feces, perhaps as a consequence of *E. histolytica/ dispar* infection, which frequently causes bloody diarrhea (Almeida & Leite, 2020).

Although most patients with AIDS were male, a higher frequency of IPIs was observed in females, which differs from the study reported by Barcelos (2016), who found a higher prevalence of females with AIDS and no sex difference in the frequency of IPIs.

Most patients with AIDS who were diagnosed with IPIs live in cities other than the State capital and have low monthly wages, which is probably related to their limited knowledge of healthy habits and poor access to basic sanitation (Brum et al., 2013). A previous study conducted in Northern Brazil also showed an association with socioeconomic conditions, reporting that 22% of HIV-positive patients with IPIs earned up to one minimum wage (Paes et al., 2020).

Regardless of whether a patient tested positive or negative for an IPI, most patients with AIDS in the present study (77.5%) had a low educational level, more than twice the number in Northern Brazil (34.9%) reported by Paes et al. (2020). This indicates that low education is an important source of social vulnerability, mainly when associated with poverty, a lack of essential sanitization, and inadequate knowledge about parasites and sexually transmitted diseases, such as HIV.

Since most patients were single, analysis of the difference in the percentage of IPI-positive and -negative patients (47% and 70%, respectively) did not reveal an association between IPI and marital status.

The habit of consuming raw and unwashed fruits and vegetables has been previously observed in patients with IPIs, and it is known that consuming food without adequate hygiene favors parasitic infection (Alves et al., 2021). Therefore, proper food disinfection is of utmost importance to avoid IPIs, especially for patients with AIDS because of immunosuppression, which emphasizes the risk of food consumption outside the home without a guarantee of appropriate hygiene during manipulation and cooking (Nunes et al., 2021).

Almost all patients with IPIs in the present study consumed unfiltered water, whereas most patients without IPIs consumed filtered water, highlighting the importance of using water filters at home to protect against parasitic infection (Oliveira et al., 2021). Boiling water apparently had no effect on the occurrence of IPIs, but a previous study reported that many patients with IPIs used boiled water, and it was ineffective in preventing parasitic infections (Paes et al., 2020).

Most patients with IPIs well-cooked their meat. Although the relationship between the level of cooking and parasites is well known, this relationship was not observed in this study. However, it is challenging to

establish how patients define "well-cooked meat". Considering the risk of parasitic infection, consuming raw fruits and vegetables is more common than that of lightly cooked meat, as demonstrated by Silva et al. (2017). Therefore, the need for education on adequate washing of fruits and vegetables and water quality should be emphasized over the level of meat cooking.

Patients with IPIs had poor or no handwashing habits before meals or after bathroom use. Such precarious hygiene habits carry a severe risk of parasitic infection and both self-contamination and dissemination, indicating that public policies regarding education on sanitary and hygiene habits are necessary (Oliveira et al., 2021).

Basic sanitation, which encompasses a clean water supply and proper waste management and disposal, is a central issue in controlling parasitosis. According to our results, many patients with IPIs obtained their water from artesian wells, which typically is not adequately treated. Contamination risks, including those from water sources, increase with inadequate waste management and disposal because direct disposal of waste into the environment can contaminate water sources, maintaining the parasite's biological cycle and perpetuating population infection. Almost 10% of the patients in the present study disposed of untreated waste directly into the environment. Although only half of these patients had an IPI, it is an important sanitary vulnerability. Only one-third of the studied patients had access to public sanitation, reinforcing the vulnerability of patients with HIV in Alagoas, as it has been observed in other municipalities (Teixeira et al., 2020).

Understandably, gastrointestinal symptoms are predominant in IPI patients, enteroparasites may cause gastrointestinal disease, which is accompanied by chronic diarrhea, dehydration, and abdominal pain (Paes et al., 2020). If not treated, it may exacerbate undernourishment, anemia, weakness, and several other complications of HIV infection (Brum et al., 2013). In this study, most patients with gastrointestinal symptoms had no IPI. This is not surprising since diarrhea in HIV patients is also caused by other infections, such as fungal or bacterial infection, as a side effect of the drugs administered for HIV treatment or a direct effect of HIV on the intestinal mucosa (Martin et al., 2021), in addition to cases of asymptomatic IPI, as it was previously reported (Casimiro, 2014).

All the HIV-positive patients included in this study were hospitalized for poor antiretroviral therapy (ART) adherence or AIDS development. Low et al. (2016) reported that effective ART is necessary to avoid opportunistic infections, as it reduces the risks and increases the success rate of treatment for opportunistic infections. This strategy must be followed to prevent the occurrence of parasites and HIV coinfection.

This study is the first of its kind to be conducted in Alagoas in a long-term study of patients with HIV/AIDS using different techniques to identify parasites along with epidemiological data collection. Controlling parasite

transmission depends on basic sanitation and adequate housing, along with public policies focused on human health, including health education, hygiene, and personal and environmental care. Additionally, routine coproparasitological examinations, regardless of the presence of clinical symptoms, should be considered for timely treatment, which is associated with effective ART and a reduced risk of opportunistic infections in HIV-positive patients.

ACKNOWLEDGEMENTS

We would like to thank the Fundação de Amparo à Pesquisa do Estado de Alagoas (FAPEAL) for the financial support to develop this scientific study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest or financial ties to disclose.

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