

Full Length Research Paper

# Prevalence of Soil-Transmitted Helminthiasis in a cohort of HIV infected children in Guediawaye hospital, suburb of Dakar, Senegal

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## Abstract

**Introduction:** Digestive symptoms are common in HIV infection. The intestinal helminthiasis are one of the most common etiologies. However, the interactions between Soil-transmitted helminths and the human immunodeficiency virus (HIV) are still poorly understood. The objective of this study is to describe the possible links between these two pathologies. **Methodology:** This is a descriptive cross-sectional study carried out in the hospital of Guédiawaye from January to June 2018. All the children followed for HIV infections who met the inclusion criteria were included in the study. The stool samples collected were examined using microscopic methods. Statistical analysis and comparison were made using the Chi2 test or the Fisher test. **Results:** A total of 109 children from the cohort underwent stool microscopy. Of these, 31 were infected with *Ascaris lumbricoides*, corresponding to an overall prevalence of 28.4%. Other soil-transmitted helminths including whipworm and hookworm, were not found. Children aged 0 to 4years had the highest infestation rate (64.52%). This rate increased with age and was more important in male patients. **Conclusion:** This study revealed a significant prevalence of soil-transmitted helminths in children living with HIV. Routine deworming should be recommended for HIV infected children in endemic areas. Further studies are needed.

**Keywords:** HIV; Soil-Transmitted helminths; pediatric population; suburb.

## INTRODUCTION

The human immunodeficiency virus (HIV) is a pathogen that attacks the body's immune system, particularly the CD4+ cells. Despite all the control activities, HIV infection remains a major public health problem worldwide with 37 million people living with HIV in 2017, of whom 1.8 million were children under 15 years old (Lakhe et al., 2020). In

Africa, most of the cases occurs in Western and Central Africa. Although, the mortality declined globally by 34%, the decrease of deaths in these two regions is only at 24% (Benzekri et al., 2019). In fact, 87% of deaths and 84% of new paediatric infections were recorded in sub-Saharan Africa. Although there has been a 50% drop in new cases of HIV infection in children since 2010, the number of newly infected children remains high in sub-Saharan Africa (Tindyebwa Det al., 2017). In West-Africa, the prevalence is low, however most of the HIV patients

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attend health facilities with advanced diseases. This situation probably due to the low level of CD4 count at ART initiation, could explain the high frequency of opportunistic infection (The leDEA and COHERE Cohort Collaborations et al., 2018). So, HIV-infected children remain vulnerable to infections, particularly helminthiasis. Indeed, it has been hypothesized that the effects of helminths on the immune system may influence the outcome of exposure to an infection with HIV. On the other hand, the effects of HIV on the immune system may influence the outcome of exposure to and infection with helminths (Morgan and Whitworth, 2001). This hypothesis was based on the concept that a T helper (Th) 2 bias, induced by helminths, was a form of immune 'dysregulation' that might be detrimental in several ways. According to some authors, a higher prevalence of HIV might occur in individuals with helminths (Brown et al., 2006).

Among the intestinal helminthiasis, a positive association has been reported between *Strongyloides stercoralis* and the HIV infection (Brown et al., 2006). However, other studies have shown a negative association between HIV and nematode infection. This observed situation could be linked either with a protective effect of nematodes against HIV infection, or with the generation, by the advancement of HIV infection, of an unfavorable environment for the establishment of nematode infection, nematode development or egg production. In other words, HIV could "protect" against the establishment or survival of mature nematode infection (Ager et al., 1998; Gomez Morales et al., 1995). For the Soil-transmitted helminthiasis (STH), there is a lack of information of the association of both infections.

STH is a major public health problem worldwide. The main species responsible for STH in humans are: *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms (*Necator americanus* and *Ancylostoma duodenale*) (WHO, 2022).

Soil-transmitted helminthiasis (STH) is one of the most common infections worldwide, affecting over 1.5 billion people (WHO, 2022). In children, these infections can have adverse effects on nutrition, growth and cognition (Bethony et al., 2006; Ruth et al., 2014). Around 866 million people in sub-Saharan Africa are infected with Soil-transmitted helminths, the majority of whom are pre-school and school-age children (Pullan et al., 2014).

In Senegal, both infections are endemic. In one hand, recent estimates have shown that there were 39,000 people living with HIV in 2020 (PLWHIV) in Senegal, including 3,900 children aged 0 - 14 years. In the suburb of the capital particularly in Guédiawaye, there was around 129 HIV children patients followed at the hospital including 93.8% of HIV 1 and 6.2% of HIV 2 (Diouf et al., 2021). In the other hand, the prevalence of STH in children remains important in Guédiawaye. Indeed, the prevalence of the STH infection at the Hospital Roi Baudouin was at 24.27% in 2018 (Niokhor et al., 2020).

Regarding the co-endemicity of both infections in Guédiawaye, it was important to assess the association of STH and HIV infection in this area.

The main objective of our study was to determine the prevalence of STH in children living with HIV in Senegal.

## MATERIALS AND METHODS

### Study site:

Our study was carried out in the Roi Baudouin Hospital of Guédiawaye in the suburb of the capital Dakar. This site has been selected due to the important number of HIV children patients followed and treated in the hospital. The Roi Baudouin hospital is located in the department of Guédiawaye, one of the four departments of the Dakar region. The site is located at 17 km from the downtown of Dakar.

### Design and study population:

A prospective descriptive cross-sectional study was carried out in a cohort of HIV pediatric patients in the Roi Baudouin Hospital from January to June 2018.

All the children attending the Guédiawaye hospital during the study period who met the following inclusion criteria were invited to participate in the study:

- Patients aged between 0 to 15 years
- Patients infected with HIV
- Parents and guardians who accepted to give the informed consent.

Children without HIV infection and without Parents' informed consent were not included in the study.

### Data collection and laboratory examinations:

A questionnaire was designed to collect data on different parameters including socio-demographical, clinical and biological aspects (age, gender, clinical stage, CD4 count, viral load, diet at inclusion, education level, stool appearance...). Each participant was invited to yield biological samples including blood and stool samples.

The stool samples were collected in appropriately sealed, labeled, and clean pots. The samples were collected in the laboratory, so the reading was done immediately or within 30 minutes. In a first step, a macroscopic and direct microscopic examination using saline water was done on each fresh stool sample. Direct examination on the fresh sample is performed by depositing on an object-carrying slide, a drop of saline water mixed with a fragment of stool collected at several locations of the sample. Following this step, all stools sample were then stained with traditional Lugol.

In another step, the concentration of the stool sample was done using the modified Ritchie technique (Formalin-ether concentration technique). This method is a two-phase concentration step. The dilution liquid is a 10%

formalin solution.

For the microscopy reading, each sample was examined by two lab technicians. A sample was considered negative if no parasite was identified after the examination of all fields on the prepared slide by the two readers.

The blood samples were used for viral load testing and CD4 count.

### Data entry and analysis:

Data were entered and analyzed using Microsoft Office Excel, version 2007. Categorical variables were described in terms of numbers, percentage of data completed and 95% confidence intervals calculated. Quantitative variables were described in terms of mean $\pm$  Standard Deviation. Statistical comparisons were made using the Chi<sup>2</sup> test or the Fisher test, depending on the conditions of applicability. The test was considered significant if the p was less than 0.05.

## RESULTS

A total of 109 children were included in the study. The mean age of the children was 4.31 years ( $\pm$  10.02), ranging from 0 to 15 years. The 0-4 years age group was the most represented with 66 children (60.55%), followed by the 5-10 years age group with 34 (31.19%) while 7 children were aged 11-15 years. The male/female sex ratio was 1.38. In term of education, there was 61 children (55.96%) at elementary school while 32 children were at secondary school. Only 3 children were not at school.

Soil-transmitted helminth infection was found in 31 children giving a prevalence at 28.4%. *Ascaris lumbricoides* was the only STH species identified in this cohort of patients. Among the infected participants, *Ascaris lumbricoides* was found alone in 28 cases. However, there was three cases of co-infection, two with *Entamoeba histolytica* and one with *Trichomonas intestinalis* (Figure 1).

STH infection was only found in the 0 - 4 years (64.52%) and 5 - 10 years (35.48%). This difference was not statistically significant ( $p=0.29$ ) (Table 1).

The frequency of STH was higher in males (51.7%) compared to the female participants. There was no association between the level of education and the STH infection. However, we have noted that the majority of infected children were in elementary school (61.29%), followed by 9 children (29.03%) in secondary school. Table 1 shows the distribution of infected children according to the socio-demographic characteristics.

Table 2 shows that the majority of infected children had HIV clinical stage I infection, i.e. 38.71% of cases. The remaining patients had a clinical stage III (32.26%), followed by those with a clinical stage II (19.35%). Only 3

infected patients had clinical stage IV. The difference between groups was statistically significant ( $p=0.0377$ ). Children co-infected with HIV and STH had a CD4 count above 500/mm<sup>3</sup> in the majority of cases (74.19%). The remaining 22.58% had CD4 counts between 200 and 500/mm<sup>3</sup>. The difference was also statistically significant ( $p=0.0002$ ). The viral load assay showed no statistically significant difference among co-infected patients. Nevertheless, we have noted that 51.61% had an undetectable viral load, while 22.58% had a high viral load. Only 3 patients (9.68%) had a low viral load (table 2).

In term of antiretroviral treatment, we have found a high rate of STH in children treated with the AZT+3TC+NVP regimen (51.61%), followed by those treated with AZT+3TC+EFV (22.58%). A low rate at 6.45% was noted in children treated with TDF+3TC+EFV and AZT+3TC+LPV/r. However, this difference was not statistically significant. Table 3 shows the distribution of infected children according to treatment regimen.

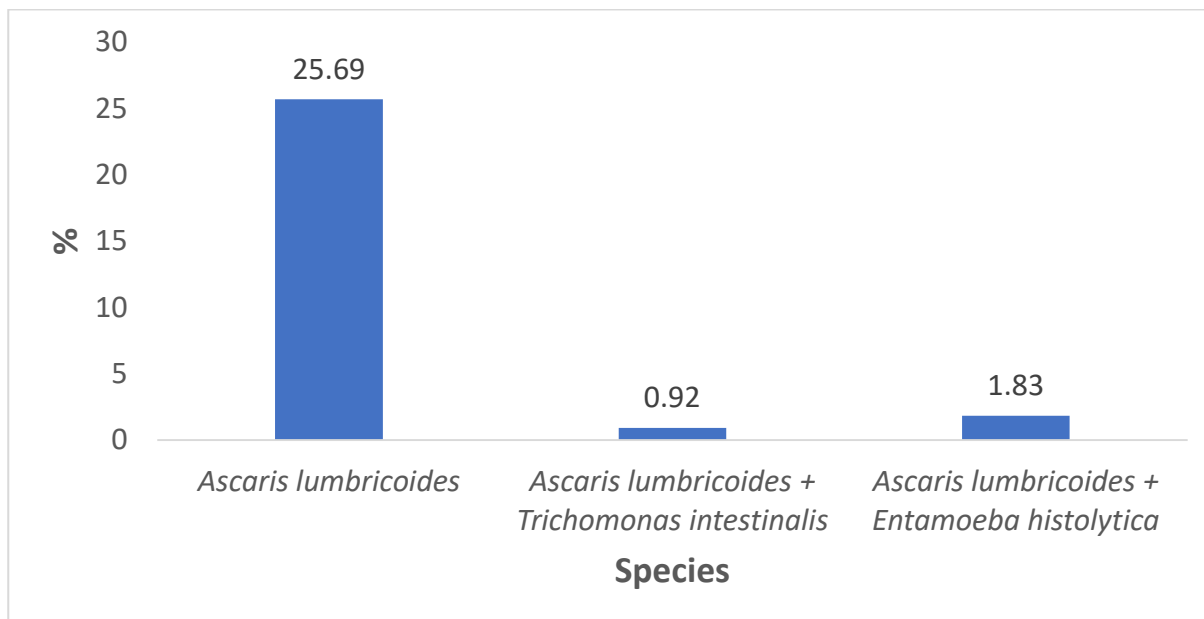
## DISCUSSION

The global burden of human immunodeficiency virus (HIV) in children under 15 years old is estimated at 1.71 million by the end of 2018 (Beltrán-Pavez et al., 2020). HIV pediatric patients are at high risk for gastrointestinal infections. Among these digestive disorders, the soil-transmitted helminths (STH) infections are one of the etiologies. The co-infection HIV and STH could have serious adverse effects on children. The main aim of this study was to determine the prevalence of STH in children living with HIV in Senegal.

We have found in our study a prevalence of *Ascaris lumbricoides* at 28.4% in children living with HIV. Similar studies have reported prevalence of STH in HIV population ranging from 0 to 48% (Akanksha et al., 2023). For example, authors in Ethiopia have reported a prevalence of 30.8% of *Ascaris lumbricoides* and 6.4% of *Trichuris trichiura* in HIV patients (Hailemariam et al., 2004). In another study in Equatorial Guinea, authors have shown a prevalence of *Ascaris lumbricoides* at 11.9% and of *Trichuris trichiura* at 23.4% (Roka et al., 2013).

Another study carried out in 2008 in Tanzania has showed a low prevalence of STH among HIV patients (18.18%). This could be due to the fact that in Tanzania, HIV-infected patients regularly receive prophylactic anthelmintic treatment (Mwambete et al., 2010). In addition, our population included children, which is not the case in the Tanzanian study. On the other hand, our results are close to those obtained in a study carried out in Kinshasa (24.6%), in HIV-positive patients (Mbala et al., 2019)

However, few studies have described prevalence of STH more than 50% in HIV patients. As observed in many other studies, *Ascaris lumbricoides* is the most endemic



**Figure1:** Distribution of children according to species.

**Table 1:** Socio-demographic characteristics.

Parameters	Number	Infected patients, n (%)	95% Confidence Interval	p-value
<b>Age, in years</b>				
0 – 4 years	66	20 (64.52%)	45.37-80.77	0.29
5 -10 years	34	11 (35.48%)	19.23-54.63	
11 – 15 years	7	-	-	
Not known	2	-	-	
<b>Gender</b>				
Male	62	16 (51.7%)	42.19-78.15	0.46
Female	45	13 (41.9%)	21.85-57.81	
Not known	2	2 (6.4%)	1.60-22.44	
<b>Educationlevel</b>				
Not at school	3	1 (3.23%)	0.08-16.70	0.79
Primary	61	19 (61.29%)	42.19-78.15	
Secondary	32	9 (29.03%)	14.22-48.04	
Other	7	1(3.23%)	0.08-16.70	
Not known	6	1 (3.23%)	0.08-16.70	

pathogen found in HIV infected patients (Akanksha et al., 2023).

However, hookworms are more prevalent in many countries, such as Burkina Faso, Democratic Republic of the Congo and Tanzania (Mbala et al.,2019; Drabo et al., 2016; Mwambete et al., 2010)

The analysis performed in this study did not reveal significant association between HIV status and *Ascaris lumbricoides* co-infection. Hailemariam and collaborators have reported similar situation in their meta-analysis and they have indicated that infection with STH is

independent of the HIV status of the patients and most likely the result of shared epidemiology (Akanksha et al., 2023).

We have found a higher risk of STH infection in the 0 - 4 age group. Although this association was not significant, it could be linked to the fact that children of this age are more in contact with the ground, and less respectful of hygiene rules. A much larger sample than ours could potentially highlight a significant association between a higher frequency of STH and the 0 - 4 years age group. Similarly, the high frequency of STH in males could be

**Table 2:** Distribution of patients according to clinical stage, the CD4 count and the viral load.

Parameters	Number	Infected patients, n (%)	95% Confidence Interval	p-value
<b>Clinical stage</b>				
I	32	12 (38.71%)	21.85-57.81	0.03
II	14	6 (19.35%)	7.45-37.47	
III	50	10 (32.26%)	16.68-51.37	
IV	10	3 (9.68%)	2.04-25.75	
Not precised	3	0	-	
<b>CD4 count</b>				
< 200	13	1 (3.23%)	0.08-16.70	0.0002
200 – 350	9	4 (12.90%)	3.63-29.83	
350- 500	5	3 (9.68%)	2.04-25.75	
≥ 500	77	23 (74.19%)	55.39-88.14	
Non precised	5	0	-	
<b>Viral load</b>				
High	25	7 (22.58%)	9.59-41.10	0.0946
Moderate	10	0	-	
Low	12	3 (9.68%)	2.04-25.75	
Not detectable	43	16 (51.61%)	33.06-68.85	
Not precise	19	5 (16.13%)	5.45-33.73	

**Table 3:** Distribution of patients according to treatment regimen.

Regimen at enrollment	Number	Infected patients, n (%)	95% Confidence Interval	p-value
AZT+3TC+EFV	28	7 (22.58%)	9.59-41.10	0.8998
AZT+3TC+LPV/r	6	2 (6.45%)	0.79-21.42	
AZT+3TC+NVP	47	16 (51.61%)	33.06-69.85	
D4T+3TC+NVP	1	0	-	
TDF+3TC+EFV	9	2 (6.45%)	0.79-21.42	
TDF+3TC+NVP	1	0	-	
Not precised	17	4 (12.90%)	3.63-29.83	

linked to the fact that boys are more in contact with the outside environment. However, a larger sample size could also reveal a significant association.

We have found a high frequency of STH in children with WHO clinical stage I. This could be linked to the fact that ARV treatment was only initiated in these children if their CD4 count is below the WHO threshold. This could be linked to the fact that antiretroviral (ARV) treatment was only started in these children if their CD4 count was below 200/mm<sup>3</sup>. Since the main action of ARVs is to suppress virus replication and strengthen the immune system, failure to administer them could have an impact on immunity, indirectly favoring a high prevalence of STH in children classified in this stage.

However, new recommendations encourage the initiation of ARVs in adults, adolescents and children living with

HIV, irrespective of CD4 count and stage of disease (Organisation mondiale de la Santé, 2016).

STH infection was more frequent in children with CD4 counts above 500/mm<sup>3</sup>. These results are similar to those found in a study carried out in Kenya in 2010, which showed that a higher CD4 count was associated with a greater frequency of STH infection (Walson et al., 2010). However, data from Tanzania differed from our own, with a much higher prevalence in patients with CD4 counts below 200 cells/mm<sup>3</sup> (Mwambete et al., 2010).

We have found no association between viral load and STH infection. So viral replication does not seem to have an impact on STH infection.

TDF+3TC+EFV and AZT+3TC+LPV/r regimens were associated with a lower incidence of geohelminths, although the association was not statistically significant.

Studies have suggested that certain antiretroviral drugs, such as lopinavir/ritonavir (LPV/r), may have activity against certain parasites, notably protozoa (Abou-El-Naga et al., 2017). However, a direct action of these drugs on STH has not yet been demonstrated. A larger sample size could potentially reveal a significant association.

Our study has some limitations. The sample size was low to allow a good comparison between the STH infected children versus non-infected patients. Furthermore, there was a lack of information on the age, the gender and the educational level of some patients. Despite these limitations, this study has established baseline data on the prevalence of STH in children living with HIV in a co-endemic setting. Based on data reported in this study, it is recommended to proceed to regular deworming of HIV-infected children in high STH endemic settings.

## CONCLUSION

This study revealed a high prevalence of STH in children living with HIV. STH infection was more frequent in children at WHO clinical stage 1 and in those with the highest CD4 counts. Viral load did not appear to have an impact on STH prevalence. In view of these results, Senegal's national HIV control program needs to implement a systematic deworming protocol using antihelminthics in children living with HIV. Furthermore, more studies are needed to assess the real burden of the co-infection and the impact on both disease severity and progression.

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## Author Contributions

DS, JBND and BF designed the study. SK, JBND have participated in the field survey and sample collection. DS performed the lab analysis. DS, KS analyzed the data. DS drafted the manuscript. IAM, SL, CBF, MN, RCT, JLN and BF reviewed the paper. All authors read and approved the final version of the manuscript.

## Ethical aspects:

The present study was part of a research project funded by the Center of Excellence for Maternal and Child Health. The study protocol had received an approval from the ethics committee of University Cheikh Anta Diop of Dakar with the number 0241/2017/CER/UCAD. Informed consent was obtained from parents and legal guardians

of the participants. Children infected with soil-transmitted helminths were treated using albendazole while the other infected patients were managed according to their symptoms.

## Informed Consent Statement:

Informed consent was obtained from all subjects involved in the study

## Data Availability Statement:

The datasets used in this study are available upon reasonable request from the corresponding author.

## Conflicts of Interests

The authors declare no conflict of interest

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