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Original Research Article

Factors associated with the increase in cases of opportunistic infections among adults living with the human immunodeficiency virus under antiretroviral treatment in Kolwezi in 2023

Bilongoli F. Lilakako[1], Mulakilwa G. Musema[1], Barigira O. Chabikuli[1], Moluantuan R. Ndwaya[1], Papayi P. Pacoma[2], Mulema N. Feti[3]*

[1]School of Public Health, University of Kinshasa, Kinshasa, Democratic Republic of Congo
[2]Department of Health of Lwalaba, Kolwezi, Democratic Republic of Congo
[3]Department of Obstetrics and Gynecology, Wits, Johannesburg, South Africa

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***Correspondence:**
Dr. Mulema N. Feti,
E-mail: noelfety@gmail.com

ABSTRACT

Background: Opportunistic infections (OIs) remain the leading cause of death among people living with human acquired immunodeficiency virus, with mortality in Africa estimated at 630,000 deaths by 2023. They present a challenge for healthcare workers and a heavy burden for those affected. From 2021 to 2023, in the city of Kolwezi, HIV-related mortality and morbidity continued to increase despite free treatment for people living with HIV (PLHIV). This increase prompted research to identify the contributing factors with this rise among adults living with HIV on antiretroviral therapy (ART). Objective was to determine the factors associated with the increase in cases of opportunistic infections among adults living with HIV receiving ART.

Methods: A cross-sectional, hospital-based analytical study was conducted between January 1, 2023, and December 31, 2023, by interviewing HIV patients and reviewing their records. Bivariate logistic regression was used to determine associations.

Results: The prevalence of OIs among people with HIV was 58% (95% CI, 53.2-62.8). The main OIs identified were oral candidiasis (27.6%) and herpes zoster (21.6%). In bivariate logistic regression, living with a pet [AOR=3.95 (95% CI, 2.15-7.26), p value <0.0001], not taking isoniazid/rifapentine (300 mg/300 mg) prophylaxis [AOR=7.84 (95% CI, 2.58-23.79), p value <0.0001], and having a chronic illness [AOR=3.70 (95% CI, 1.87-7.26), p value <0.0001] were associated with OIs.

Conclusions: The prevalence of OIs in Kolwezi is the highest in Africa, and factors such as not taking isoniazid/rifapentine prophylaxis, having a chronic illness, and living with a pet were associated with a rise of OIs among PLHIV.

Keywords: Opportunistic infections, PLHIV, Rifapentine

INTRODUCTION

Human immunodeficiency virus (HIV) infection is caused by a ribonucleic acid (RNA) virus from the retrovirus family that was discovered in the United States in the 1980s.[1,2] With an estimated 42.3 million deaths to date, HIV continues to be a serious global public health concern. It was in this context that the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) set targets to be achieved by 2030 for the elimination of HIV as a public health problem through increased testing, treatment and preventive strategies.[3] WHO/UNAIDS estimated that 39.9 million people were living with HIV in 2023 and 630,000 HIV-related deaths worldwide.[4] The prevalence of opportunistic infections (OIs) worldwide varies over

time and by geographic area. It varies and depends on the specificities of each country; It is estimated at 33.51% in seven provinces of Indonesia.[5] Variations in the prevalence of OIs may be associated with factors such as education level, gender, region of residence, hygiene, and nutritional status.[6] It is estimated at 46% according to a study on the causes of hospitalization of people living with HIV and 63.4% in Vietnam in 2020.[7,8]

The prevalence of OIs at the African level is not known, but it varies between regions within the same country and between countries. In Mogadishu (Somalia), the prevalence of OIs among people living with HIV (PLHIV) is estimated at 37.1%, while in Ethiopia, it is estimated between 33.6 and 88.44% and 22.4% in South-eastern Nigeria.[5,9] In the Democratic Republic of Congo (DRC), HIV is a public health problem and is widespread.[10] The prevalence of OIs in the country is unknown, but UNAIDS estimates that 16,000 deaths attributed to HIV as of December 31, 2022.[11] According to the provincial coordination of the national acquired immunodeficiency syndrome (AIDS) control program/Lualaba, the province has seen an increase in the number of PLHIV hospitalized and deceased since 2021.

Study objective

The objective of this study is to determine the factors associated with the increase in cases of opportunistic infections (OIs) among adults living with HIV on ART in Kolwezi in 2023.

Specific objectives

To determine the proportion of adults living with HIV on ART who developed OIs in 2023. To describe the sociodemographic characteristics of adults living with HIV on ART who developed OIs in Kolwezi in 2023. To describe the clinical/paraclinical characteristics of adults living with HIV on ART who developed OIs in Kolwezi in 2023.

METHODS

A hospital-based cross-sectional analytical study was conducted between January 1 and December 31, 2023, to determine the factors associated with the increase in opportunistic infections among adults living with HIV on ART in Kolwezi.

Study setting

This study took place in the DRC, in the city of Kolwezi, Lualaba province. MWANGEJI Hospital was the study hospital, it is a public referral hospital managed by the Ministry of Public Health and has the second largest ART centre.

Study population, inclusion and exclusion criteria

Adults (≥18 years) living with HIV/AIDS who had or did not have signs of opportunistic infections and who had complete patient records were included in the study. PLHIV with or without opportunistic infections, however, were excluded if they had incomplete medical records (HIV/AIDS clinical stage, viral load, diagnosis of OI, etc.), had not verbally communicated, were mentally unfit, were in critical care, or had significant health issues.

Sample size calculation

The sample size was calculated using the standard formula for cross-sectional studies.[12]

$$n \geq \frac{Z_{\alpha}^{2}\, p(1-p)}{d^{2}}$$

where Z_{α}^{2} was a confidence level of 1.96, p is the estimated prevalence proportion of OIs in Mogadishu which was 37.1%, and d is the desired precision level, which is set at 0.05.[8]

$$n \geq \frac{(1.96)^{2} \times 0.37 \times (1-0.37)}{(0.05)^{2}}$$

=358

The total sample size required for the study was 358, plus an additional 10% to prevent non-response, which equals 394. The sample size, when rounded, was 400 people living with HIV.

Research tools and variables

A validated and well-developed questionnaire based on literature review was used for data collection.[13-18] The dependent variable was the presence or absence of opportunistic infection among people living with HIV on ART. The independent variables were age, gender, marital status education level, and location for sociodemographic characteristics, while clinical/ paraclinical characteristics (viral load, comorbid chronic diseases, WHO clinical stage, cotrimoxazole prophylaxis, isoniazid/rifapentine prophylaxis, ART adherence and duration on ART) and behavioural characteristics (living with a pet and disclosure of HIV status) were used. To estimate ART adherence, the number of prescribed pills memorized in the last month was calculated to measure ART adherence. Those with a recall rate of 95% or less were classified as having poor ART adherence.[18]

Sampling technique

A single-stage systematic sampling technique was used to select study participants.

Data collection process

After obtaining permission from hospital management to access patient records, well-trained interviewers conducted 30-minute face-to-face interviews and reviewed patient records in a private room at the hospital.

Statistical analysis

The collected data were entered into EPIDATA and exported to SPSS 25 for processing. Analysis was performed using SPSS 25, where the data were summarized in tables. The key information to be analysed by area of intervention was presented in tables, and descriptive and inferential statistics were used for the analysis at a 95% significance level. For descriptive statistical analyses, quantitative variables (age, duration on ART) were summarized using the median and interquartile range because they did not follow a normal distribution, while categorical variables (gender, marital status, education level, and location) were summarized as frequencies and percentages. The magnitude of OIs was calculated as a percentage with a 95% CI. For inferential statistics, univariate and bivariate analyses were used to determine factors associated with opportunistic infections.

Ethical considerations

Before beginning data collection, the team had obtained prior authorizations at various levels: approval from the ethics committee of the Kinshasa School of Public Health (ESP/CE/207/2024), the head of the provincial health division, the chief physician of the Manika Zone, and the Medical Director of Mwangeji Hospital.

RESULTS

Sociodemographic characteristics

We evaluated a total of 400 participants living with HIV/AIDS in this study from January to December 2023. The majority were women (62.7%) and aged between 30 and 45 years old (53.5%). In addition to 93.7% living in urban areas, 44.7% were married and 48.5% had completed secondary education (Table 1).

Distribution of PLHIV by clinical, paraclinical, and behavioural characteristics

Of all the participants, most of them had a viral load below 1000 copies/ml (88.3%) and without any chronic comorbid diseases (78.5%). More than half of the PLHIV were in WHO stage 2 of the infection (51.5%). The ART adherence was poor among the participants (58%). The quasi-totality of PLHIV received cotrimoxazole prophylaxis (96.7%) and isoniazid/rifapentine prophylaxis (87%). Within a year of the beginning of ART a significant number of participants developed OIs (47.8%). Of all the PLHIV, three out of ten lived with pets and three out of ten did not disclose their HIV status (Table 2).

Table 1: Sociodemographic characteristics (n=400).

Sociodemographics	N	%
Age group (years) median age (IQR) :39 (31.6-46.4)		
18-29	91	22.8
30-45	214	53.5
>45	95	23.7
Total		100
Gender		
Female	251	62.7
Male	149	37.3
Total		100
Marital status		
Married	179	44.7
Single	93	23.3
Divorcee	73	18.3
Widowed	55	13.7
Total		100
Level of education		
None	17	4.3
Primary	145	36.2
Secondary	194	48.5
University	44	11
Total		100
Location		
Urban	375	93.7
Rural	25	6.3
Total		100

Table 2: Clinical, paraclinical and behavioural characteristics (n=400).

Characteristics	N	%
Last viral load (copies/ml)		
<1000	353	88.3
>1000	47	11.7
Total		100
Comorbidities		
No	314	78.5
Yes	86	21.5
Total		100
WHO stages		
Stage 1	29	7.3
Stage 2	206	51.5
Stage 3	154	38.5
Stage 4	11	2.7
Total		100
ART adherence		
Poor	232	58
Good	168	42
Total		100
Cotrimoxazole prophylaxis		
No	13	3.3
Yes	387	96.7
Total		100
Isoniazid/rifapentine prophylaxis		
No	52	13
Yes	348	87
Total		100
Duration on ART (years)		
<1	191	47.8
1-3	36	9
>3	173	43.2
Total		100
Living with a pet		
No	283	70.8
Yes	117	29.2
Total		100
Disclosure of HIV status		
No	121	30.2
Yes	279	69.8
Total		100

Table 3: Frequency of OIs in PLHIV on ART (n=400).

PLHIV with OI	N	%	95%CI
No	168	42	
Yes	232	58	53.2-62.8
Total		100	

Extent and type of opportunistic infections

More than half of PLHIV on ART had OIs (58%) (95% CI: 53.2-62.8%) (Table 3). The most common OIs were oral candidiasis (27.6%), shingles (herpes zoster) (21.5%), bacterial pneumonia (18.5%), pulmonary tuberculosis (15.1%), diarrheal infections (9.5%), and malaria (7.8%) (Table 4).

Table 4: Types of OIs (n=232).

Opportunistic infections	N	%
Oral candidiasis	64	27.6
Herpes zoster	50	21.5
Bacterial pneumonia	43	18.5
Pulmonary tuberculosis	35	15.1
Diarrheal infections	22	9.5
Malaria	18	7.8
Total		100

Table 5: Factors associated with the magnitude of OIs in PLHIV.

Factors	Présence of OIs		OR Crude (95% CI)	OR Adjusted (95% CI)	P value
	No (%)	Yes (%)			
Age (years)					
18-29 (n=91)	41 (45.1)	50 (54.9)	1	1	
30-45 (n=214)	98 (45.8)	116 (54.2)	0.97 (0.59-1.59)	0.96 (0.54-1.70)	0.884
>45 (n=95)	29 (30.5)	66 (69.5)	1.87 (1.02-3.40)	1.43 (0.70-2.93)	0.332
Gender					
Male (n=149)	68 (45.6)	81 (54.4)	1		
Female (n=251)	100 (39.8)	151 (60.2)	1.27 (0.84-1.91)		
Marital status					
Widowed (n=55)	22 (40.0)	33 (60.0)	1		
Single (n=93)	45 (48.4)	48 (51.6)	0.73 (0.37-1.43)		
Married (n=179)	78 (43.6)	101 (56.4)	0.85 (0.46-1.58)		
Divorcee (n=73)	23 (31.5)	50 (68.5)	1.45 (0.70-3.01)		
Level of education					
None (n=17)	8 (47.1)	9 (52.9)	1		
Primary (n=145)	55 (37.9)	90 (62.1)	1.09 (0.37-3.23)		
Secondary (n=194)	85 (43.8)	109 (56.1)	0.85 (0.29-2.47)		
University (n=44)	20 (45.5)	24 (54.5)	0.76 (0.23-2.50)		
Location					
Rural (n=25)	7 (28.0)	18 (72.0)	1		
Urban (n=375)	161 (42.9)	214 (57.1)	0.52 (0.21-1.27)		
Last viral load (copies/ml)					
<1000 (n=353)	157 (44.5)	196 (55.5)	1	1	
>1000 (n=47)	11 (23.4)	36 (76.6)	2.62 (1.29-5.32)	2.09 (0.92-4.71)	0.076
Comorbidities					
No (n=314)	154 (49.0)	160 (51.0)	1		
Yes (n=86)	14 (16.3)	72 (83.7)	4.95 (2.68-9.14)	3.70 (1.87-7.26)	< 0.0001
WHO stages					
Stage 1 (n=29)	15 (51.7)	14 (48.3)	1		
Stage 2 (n=206)	105 (51.0)	101 (49.0)	1.03 (0.47-2.24)	1.07 (0.43-2.6)	0.89
Stage 3 (n=154)	47 (30.5)	107 (69.5)	2.44 (1.09-5.46)	2.19 (0.86-5.5)	0.99
Stage 4 (n=11)	1 (9.1)	10 (90.9)	10.71 (1.21-94.86)	5.5 (0.51-59.08)	0.16
ART adherence					
Good (n=168)	94 (56.0)	74 (44.0)	1		
Poor (n=232)	74 (31.9)	158 (68.1)	2.71 (1.80-4.09)	0.11 (0.91-2.40)	1.5
Isoniazid/rifapentine prophylaxis					
Yes (n=348)	164 (47.1)	184 (52.9)	1		
No (n=52)	4 (7.7)	48 (92.3)	10.70 (3.78-30.31)	7.84 (2.58-23.79)	<0.0001
Duration on ART (years)					
>3 (n=173)	71 (41.0)	102 (59.0)	1		
1-3 (n=36)	10 (27.8)	26 (72.2)	1.81 (0.82-3.98)		
<1 (n=191)	87 (45.5)	104 (54.5)	0.83 (0.55-1.26)		
Cotrimoxazole prophylaxis					
Yes (n=387)	166 (42.9)	221 (57.1)	1		
No (n=13)	2 (15.4)	11 (84.6)	4.13 (0.90-18.89)		
Living with a pet					
No	146 (87)	137 (59)	1		
Yes	22 (13)	95 (41)	4.94 (2.92-8.37)	3.95 (2.15-7.26)	<0.0001
Disclosure of HIV status					
Yes (n=279)	111 (39.8)	168 (60.2)	1		
No (n=121)	57 (47.1)	64 (52.9)	0.74 (0.48-1.14)		

Factors associated with opportunistic infections in adults living with HIV

In the univariate regression analysis model, seven factors were associated with opportunistic infections: age (over 45 years), viral load over 1000 copies/ml, WHO clinical stage (3 and 4), poor ART adherence, having a chronic disease, not receiving isoniazid/rifapentine prophylaxis, and living with a pet. Of these factors, three were statistically associated with OIs in the bivariate regression: having a chronic disease, not receiving isoniazid/rifapentine prophylaxis, and living with a pet.

The risk of developing OIs was significantly higher for PLHIV with a chronic disease compared to those without any chronic comorbid disease [AOR=3.70, 95% CI (1.87-7.26)]. Not receiving isoniazid/rifapentine prophylaxis was also significantly associated with higher OIs compare to receiving prophylaxis [AOR=7.84, 95% CI (2.58-23.79)]. And participants living with pets were at higher risk of developing OIs than those living without pets [AOR=3.95, 95% CI (2.15-7.26)] (Table 5).

DISCUSSION

This study described the people living with HIV (PLHIV) on ART, looking at various factors associated with the increase risk of opportunistic infections (OIs). The results of this study show that the prevalence of OIs in Kolwezi is 58%, which is similar to 57.9% found in Gabon in 2024.[5] However, this prevalence is higher than that found in Mogadishu (37.1%) in 2023, in Indonesia (33.5%) in 2018, in Ghana (33.1%) in 2024, in the Tigray region of Ethiopia (55.3%) in 2020, in Ethiopia (21.9%) in 2019, in Addis Ababa (29.2%) in 2019 and in southern Ethiopia (42.5%) in 2024. On the other hand, it is lower than the 63.4% found in Hanoi in 2020.[8,9,16,17,19-22]

These differences can be explained by various patient-related factors, the data collection period, the sample size (fewer than 400 for many authors consulted), the geographic location, exposure to infections and microbial agents, methodology, and drug resistance.

In terms of living with pets, 29.2% of PLHIV who developed OIs lived with pets. Living with pets was significantly associated with increased risk to develop OIs compared to those who did not [AOR=3.95, 95% CI (2.15-7.26), p value <0.0001]. This result was similar to that obtained in Mogadishu in 2023 which found an (AOR=4.012, 95% CI: 1.651-4.123) while it was lower than that found in Ethiopia in 2017 (AOR=6.14 95% CI: 3.13, 12.0).[8,9]

The lack of prophylaxis with isoniazid/rifapentine was significantly related to the higher risk of developing OIs compare to the PLHIV without isoniazid/rifapentine prophylaxis [AOR=7.84 (95% CI: 2.58-23.79), p value <0.0001]. A similar finding was also documented by a study in eastern Ethiopia in 2017.[23]

This study has also found that there was a statistically significant association between PLHIV suffering from a chronic comorbid disease and OIs as compare to those not suffering from a chronic comorbid disease [AOR=3.70 (95% CI: 1.87-7.26), p value <0.0001]. This is comparable to the study conducted in Mogadishu in 2023.[8] Our study has shown that 21.5% of PLHIV with a chronic comorbid disease subsequently developed OIs, which is higher than the 13% found in the United States in 2005 and the 11.5% found in the Democratic Republic of Congo in 2017.[24,25] Conversely however, our results are lower than the 26.2% found in Italy in 2018 and the 23.7% found in Malawi in 2016.[26,27]

With respect to the viral load, our study has also found that PLHIV with a viral load greater 1000 copies/ml had higher chance of developing OIs than those with a viral less than 1000 copies/ml even though the difference was not statistically significant. This corresponds with a similar finding of a study done in the Democratic Republic of Congo in 2022.[28]

This study conducted in Kolwezi, a city located in the southeast of the DRC, identified four most important OIs specifically oral candidiasis, shingles, bacterial pneumonia, and pulmonary tuberculosis.

This study is the first in Kolwezi to evaluate the factors associated with the increase in opportunistic infections among PLHIV on ART. It addressed a long-neglected area in the care of PLHIV. Limitations include the lack of complete information in the file on ART adherence. The causal relationship between predictor variables and OIs cannot be estimated due to the nature of the cross-sectional study, bias in the information provided by some PLHIV regarding the number of pills taken, and certain variables (screening for other pathologies such as toxoplasmosis and cryptococcosis). Moreover, the study did not assess the correlation between the level of the CD4 count and OIs. The study was conducted in a hospital setting and targeted HIV-positive patients receiving ART, so results may differ from those in the general population.

CONCLUSION

In conclusion, he objective of this study was to determine the factors associated with the increase in cases of opportunistic infections (OIs) among adults living with HIV on ART. The median age of PLHIV included in this study was 39 years (IQR: 14.8). The prevalence of OIs was 58%, one of the highest in Africa, demonstrating that OIs remain a challenge for PLHIV and healthcare workers. The main OIs encountered were oral candidiasis, shingles, bacterial pneumonia, and pulmonary tuberculosis, while factors that showed a statistical association were living with a pet, not taking isoniazid/rifapentine and suffering from a chronic comorbidity. High blood pressure and diabetes were

identified as the most common chronic diseases in this study.

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Ethical approval: The study was approved by the Institutional Ethics Committee of the Kinshasa School of Public Health under No. ESP/CE/207/2024

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