Factors Associated with Opportunistic Infections Among HIV-Positive Patients: A Retrospective Study

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Article

Factors Associated with Opportunistic Infections Among HIV-Positive Patients: A Retrospective Study

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Abstract: Background/objective: A retrospective study was conducted to access better understanding of the prevalence and risk factors of OIs in HIV-positive individuals, informing targeted interventions and enhancing overall health outcomes. **Methods:** Medical records 212 of patients (61.79% female, 38.21% male) were accessed to extract relevant information for the study. Fisher's exact test revealed significant associations between gender, substance abuse, healthy diet practices, and having single or multiple partners with the development of opportunistic infections.**Results:** A total of 212 HIV-positive patients were enrolled, with a majority being female (61.79%) and adults aged between 25 and 65 years (68.87%). Most participants were single (83.02%), unemployed (66.9%), and had a history of substance abuse (61.79%). The prevalence of opportunistic infections was 15.09%, with pulmonary tuberculosis being the most common (75%), followed by extrapulmonary tuberculosis (18.75%) and herpes zoster (6.25%). Females were less likely to develop opportunistic infections compared to males (OR=0.26; 95% CI: 0.12 to 0.57; p=0.0007). Patients not using substances were less likely to develop opportunistic infections (OR=0.32; 95% CI: 0.13 to 0.82; p=0.0170). Those with unhealthy diet practices were significantly more likely to develop opportunistic infections (OR=8.46; 95% CI: 3.56 to 20.53; p<0.0001). Patients with multiple partners were more likely to develop opportunistic infections (OR=3.33; 95% CI: 1.27 to 9.26; p=0.0250). **Conclusion:** These findings highlight the importance of addressing these factors in the management of HIV-positive patients to reduce the risk of opportunistic infections.

Keywords: opportunistic infection; HIV-positive patients; retrospective study; risk factors

1. Introduction

The human immunodeficiency virus (HIV) is a virus that targets the human immune system, leading to the depletion of CD4+ T-cells, which are crucial for immune function (Vidya Vijayan et al., 2017) [1]. HIV is transmitted through various routes, including unprotected sexual contact with exchange of body fluids such as seminal and vaginal fluids, blood transfusions from infected individuals, injection drug use, and vertical transmission from mother to child during pregnancy, childbirth, or breastfeeding. Without treatment, individuals living with HIV are at increased risk of opportunistic infections (OIs), which are caused by unusual pathogens that exploit the weakened immune system, leading to illness and mortality (Iroezindu, 2016) [2].

Opportunistic infections (OIs) remain a significant cause of morbidity and mortality among HIV-positive patients, despite the widespread availability of antiretroviral therapy (Manosuthi, Charoenpong & Santiwarangkana, 2021) [3]. These infections, which include tuberculosis, candidiasis, and pneumocystis pneumonia, occur more frequently and with greater severity in individuals with compromised immune systems (Woldegeorgis et al., 2023) [4]. The prevalence and impact of OIs vary globally, influenced by factors such as geographic location, access to healthcare, and the effectiveness of ART programs (Melkamu et al., 2020) [5].

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In resource-limited settings, the burden of OIs is particularly high. Studies have shown that poor adherence to ART, low CD4+ T-cell counts, and advanced HIV disease stages are significant predictors of OI development (Tawiye, Assefa & Zengye, 2021) [6]. For instance, a systematic review and meta-analysis conducted in Ethiopia reported a pooled OI prevalence of 43.97% among HIV-infected adults receiving ART, with poor ART adherence and low CD4+ counts being major contributing factors (Kebede et at., 2021) [7]. Similarly, research in Nigeria and Indonesia highlighted tuberculosis and candidiasis as the most common OIs among HIV-positive individuals (Oladele & Osibogun, 2021; Sharma & Mohan, 2020) [8,9].

The introduction of ART has significantly reduced the incidence of OIs by improving immune function and reducing viral load. However, the persistence of OIs in some populations suggests that additional factors, such as socioeconomic status, nutritional deficiencies, and co-infections, may also play critical roles. Understanding these factors is essential for developing targeted interventions to further reduce the burden of OIs among HIV-positive patients. This retrospective study aims to identify the factors associated with opportunistic infections among HIV-positive patients in a specific healthcare setting. By analyzing patient records and clinical data, we seek to elucidate the key determinants of OI occurrence and provide insights that can inform clinical practice and public health strategies. The findings of this study will contribute to the existing body of knowledge and support efforts to improve the management and outcomes of HIV-positive individuals.

By conducting a retrospective study, we intend to access better understanding of the prevalence and risk factors of OIs in HIV-positive individuals, informing targeted interventions and enhancing overall health outcomes. Identifying the most common OIs and their associated risk factors will help develop effective prevention strategies and educate both the community and healthcare providers about managing these infections.

2.1. Methodology

2.1.1. Study Design and Setting

This study is a cross-sectional retrospective analysis conducted at Mthatha Gateway Clinic, located in Mthatha, King Sabata Dalindyebo Local Municipality, Eastern Cape Province, South Africa. The study period spans from January 2021 to December 2022.

2.1.2. Target Population

The target population comprised all patients diagnosed with HIV and HIV-associated opportunistic infections (OIs) who attended Mthatha Gateway Clinic during the specified two-year period. Inclusion criteria were patients aged above 18 years diagnosed with HIV and associated OIs within the study period. Exclusion criteria included non-HIV patients, individuals hospitalized for non-opportunistic infections, patients with OIs not related to HIV, and records of patients diagnosed outside the study period.

2.1.3. Sampling Method

A simple random sampling method was employed to select a representative sample from the clinical records. This probability sampling technique ensured that each patient had an equal chance of being selected, thereby minimizing selection bias and ensuring a fair representation of the population.

2.1.4. Sample Size Calculation:

The sample size was determined using the single population proportion formula, considering a 95% confidence level ($Z_{\propto} = 1.96$), a 5% margin of error, and an estimated 16.5% prevalence of OIs among HIV-positive individuals based on data from Johannesburg, South Africa. The calculated sample size was 212 clinical records, which was deemed representative of the study population.

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2.1.5. Data Collection

Secondary data were obtained from the clinical records of Mthatha Gateway Clinic. The data included variables such as opportunistic infections, socio-demographic characteristics (e.g., age, occupation), and lifestyle characteristics (e.g., substance abuse, healthy diet practices). Permission to access these records was obtained from the clinic's healthcare management. To ensure data accuracy, duplication was avoided, and the data were translated from soft copies to an Excel spreadsheet.

2.1.6. Data Analysis

All collected data were captured in Microsoft Excel and analyzed using GraphPad Prism software. Descriptive analysis was performed to summarize the general characteristics and prevalence of HIV-associated OIs. Results were presented in the form of graphs and statistical tables. Contingency analysis was conducted to identify risk factors associated with OIs using Fisher's exact test. A 95% confidence interval was used, and a p-value of less than 0.05 was considered statistically significant.

2.1.7. Data Management

The secondary data were securely stored on a password-protected laptop and archived in the university research database for long-term storage. Data management protocols ensured the confidentiality and integrity of the data throughout the study.

2.2. Ethical Considerations

The study was approved by the Human Research Ethics Committee of Walter Sisulu University, Faculty of Health Sciences (124/2023), and the Eastern Cape Health Research Committee. All procedures adhered to ethical standards for research involving human subjects.

3. Results

3.1. Social Demographics

The socio-demographic characteristics of the HIV-positive patients included in this study are summarized in Table 1. The study population comprised a total of 212 patients, with a higher proportion of females (61.79%) compared to males (38.21%). The age distribution indicated that most patients were adults aged between 25 and 65 years (68.87%), followed by young adults aged 18 to 25 years (29.25%), and a small percentage of patients were over 65 years old (1.89%).

Regarding marital status, a significant majority of the patients were single (83.02%), while 15.09% were married, 1.42% were widowed, and only 0.47% were in cohabitation. Employment status revealed that a larger proportion of the patients were unemployed (66.98%) compared to those who were employed (33.02%). Among the employed patients, 51.43% were formally employed, and 48.57% were self-employed.

Table 1. Socio-Demographic Characteristics of HIV-Positive Patients.

Variables	Number of Patients	Percentage
Gender		
Male	81	38.21%
Female	131	61.79%
Age		

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Variables	Number of Patients	Percentage
Young adult (18-25 y)	62	29.25%
Adults (25-65 y)	146	68.87%
Old age (> 65 y)	4	1.89%
Marital Status		
Single	176	83.02%
Cohabitation	1	0.47%
Married	32	15.09%
Widowed	3	1.42%
Employment Status		
Employed	70	33.02%
Unemployed	142	66.98%
Type of Employment		
Self-employed	34	48.57%
Formally employed	36	51.43%

3.2. Lifestyle Characteristics

The lifestyle characteristics of the HIV-positive patients are summarized in Table 2. A notable proportion of the patients reported engaging in substance abuse, with 61.79% indicating yes and 38.21% indicating no. Among those who abused substances, the majority (72.52%) engaged in single substance abuse, while 27.48% reported both alcohol and smoking. Specifically, alcohol was the predominant substance abused (87.37%), compared to smoking (12.63%).

Healthy eating habits were prevalent among the patients, with 84.91% reporting adherence to healthy eating practices, while 15.09% did not follow such practices. Regarding sexual behavior, 82.08% of the patients had sexual partners, and 17.92% did not. Among those with sexual partners, the majority had a single partner (87.93%), while 12.07% had multiple partners.

Condom use varied significantly between those with single and multiple partners. Among patients with a single partner, 35.95% used condoms, whereas 64.05% did not. In contrast, among those with multiple partners, only 14.29% used condoms, and a substantial 85.71% did not.

Table 2. Lifestyle Characteristics of HIV-Positive Patients.

Variables	Number of Patients	Percentage
Substance Abuse		
Yes	131	61.79%

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Variables	Number of Patients	Percentage
No	81	38.21%
Type of Abuse		
Single abuse	95	72.52%
Both abuse	36	27.48%
Single Abuse		
Alcohol	83	87.37%
Smoking	12	12.63%
Healthy Eating		
Yes	180	84.91%
No	32	15.09%
Sexual Partner		
Yes	174	82.08%
No	38	17.92%
Number of Partners		
Single partner	153	87.93%
Multiple partners	21	12.07%
Condom Use (Single Partner)		
Use condoms	55	35.95%
Don't use condoms	98	64.05%
Condom Use (Multiple Partners)		
Use condoms	3	14.29%
Don't use condoms	18	85.71%

3.3. Types and Prevalence of Opportunistic Infections

The prevalence and types of opportunistic infections (OIs) among the HIV-positive patients are detailed in Table 3. Out of the total study population, 15.09% (32 patients) were diagnosed with OIs, while the remaining 84.91% (180 patients) did not have any OIs.

Among the patients with OIs, pulmonary tuberculosis (TB) was the most common, affecting 75% (24 patients) of those with OIs. Extrapulmonary TB was the second most prevalent, accounting for

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18.75% (6 patients) of the OI cases. Herpes zoster was identified in 6.25% (2 patients) of the patients with OIs.

Table 3. Types and Prevalence of Opportunistic Infections Among HIV-Positive Patients.

Opportunistic Infections	Number of Patients	Percentage
Yes	32	15.09%
No	180	84.91%
Types of Opportunistic Infections		
Pulmonary TB	24	75%
Extrapulmonary TB	6	18.75%
Herpes Zoster	2	6.25%

3.4. Associated Factors for Opportunistic Infections

The analysis of factors associated with opportunistic infections (OIs) among HIV-positive patients revealed several significant associations. Gender was a notable factor, with females having a lower likelihood of developing OIs compared to males (OR = 0.26, 95% CI: 0.12 to 0.57, $p < 0.05$). Age did not show a significant association with OIs, although adults aged 25-65 years had a slightly higher odds ratio (OR = 1.33, 95% CI: 0.57 to 2.99) compared to young adults aged 18-25 years.

Marital status indicated that married individuals had more than twice the odds of developing OIs compared to single individuals (OR = 2.22, 95% CI: 0.91 to 5.39), though this was not statistically significant. Employment status did not significantly affect the likelihood of OIs, with unemployed individuals having an odds ratio of 1.10 (95% CI: 0.50 to 2.41) compared to employed individuals.

Substance abuse was significantly associated with OIs. Patients who did not abuse substances had a lower likelihood of developing OIs (OR = 0.32, 95% CI: 0.13 to 0.82, $p < 0.05$). Among those who abused substances, both alcohol and smoking (dual abuse) were associated with a higher likelihood of OIs (OR = 3.57, 95% CI: 1.52 to 8.41, $p < 0.05$) compared to single substance abuse. Specifically, smoking was strongly associated with OIs (OR = 4.11, 95% CI: 1.17 to 17.30, $p < 0.05$) compared to alcohol abuse.

Dietary habits also showed a significant association with OIs. Patients who did not follow a healthy diet had significantly higher odds of developing OIs (OR = 8.46, 95% CI: 3.56 to 20.53, $p < 0.05$) compared to those who adhered to healthy eating practices. The presence of a sexual partner and the number of sexual partners did not show a significant association with OIs.

These findings highlight the importance of addressing lifestyle factors such as substance abuse and dietary habits in the management of HIV-positive patients to reduce the risk of opportunistic infections. The significant associations observed suggest that targeted interventions focusing on these modifiable factors could be beneficial in improving health outcomes for this population.

Table 4. Associated Factors for Opportunistic Infections Among HIV-Positive Patients.

Variables	Opportunistic Infections	OR (95% CI)	P-value
	Yes	No	
Gender			

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Variables	Opportunistic Infections	OR (95% CI)	P-value
Male	21	60	Ref
Female	11	120	0.26 (0.12 to 0.57)
Age			
Young adult (18-25 y)	8	54	Ref
Adults (25-65 y)	24	122	1.33 (0.57 to 2.99)
Old age (> 65 y)	0	4	0.00 (0.00 to 8.82)
Marital Status			
Single	23	153	Ref
Cohabitation	1	0	0.00 (0.00 to 1.41)
Married	8	24	2.22 (0.91 to 5.39)
Widowed	0	3	0.00 (0.00 to 7.94)
Employment Status			
Employed	10	60	Ref
Unemployed	22	120	1.10 (0.50 to 2.41)
Type of Employment			
Self-employed	7	27	Ref
Formally employed	3	33	0.35 (0.09 to 1.51)
Substance Abuse			
Yes	26	105	Ref
No	6	75	0.32 (0.13 to 0.82)

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Variables	Opportunistic Infections	OR (95% CI)	P-value
Type of Abuse			
Single abuse	13	82	Ref
Both abuse	13	23	3.57 (1.52 to 8.41)
Single Abuse			
Alcohol	9	74	Ref
Smoking	4	8	4.11 (1.17 to 17.30)
Healthy Diet			
Yes	17	163	Ref
No	15	17	8.46 (3.56 to 20.53)
Sexual Partner			
Yes	27	147	Ref
No	5	33	0.83 (0.33 to 2.22)

4. Discussion

4.1. Socio-Demographic Characteristics

The findings of this study highlight the socio-demographic diversity within the study population and underscore the potential influence of factors such as gender, age, marital status, and employment on the health outcomes of HIV-positive individuals. The study included 212 HIV-positive patients, with a higher proportion of females (61.79%) compared to males (38.21%). This gender distribution aligns with other studies indicating a higher prevalence of HIV among females, potentially due to biological, social, and economic factors (Seid *et al*., 2020) [10]. Most participants were adults aged 25-65 years (68.87%), which is consistent with the age group most affected by HIV globally (Armoon et al., 2021) [11]. The high percentage of single participants (83.02%) may reflect the social stigma and relationship challenges faced by HIV-positive individuals (Dambach et al., 2021) [12]. Additionally, the high unemployment rate (66.98%) among participants underscores the economic impact of HIV, as employment status is often adversely affected by the disease (Madundo et al., 2023) [13].

4.2. Lifestyle Characteristics

Substance abuse was prevalent among 61.79% of the participants, with alcohol being the most abused substance (87.37%). This finding is significant as substance abuse can exacerbate HIV progression and complicate treatment adherence. Healthy eating practices were reported by 84.91% of participants, which is crucial for maintaining immune function and overall health in HIV-positive individuals (Catalan et al., 2017) [14]. Many participants had sexual partners (82.08%), with a

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significant portion not using condoms (64.05% among those with single partners and 85.71% among those with multiple partners). This highlights the ongoing risk of HIV transmission and the need for targeted interventions to promote safer sexual practices. These findings provide valuable insights into the lifestyle behaviors of HIV-positive patients, highlighting areas where targeted interventions could improve health outcomes. Addressing substance abuse, promoting healthy eating, and encouraging safe sexual practices are critical components of comprehensive care for this population

4.3. Associated Factors for Opportunistic Infections

The study identified several factors significantly associated with the development of OIs. Female participants were less likely to develop OIs compared to males (OR=0.26, 95% CI: 0.12 to 0.57, p=0.0007), which may be due to differences in health-seeking behaviors and access to care (Tewachew et al., 2020) [15]. Substance abuse was a significant risk factor, with those not using substances being less likely to develop OIs (OR=0.32, 95% CI: 0.13 to 0.82, p=0.0170). This aligns with existing literature that links substance abuse to increased susceptibility to infections (Hailu et al., 2020) [16]. Additionally, participants with both types of substance abuse were more likely to develop OIs (OR=3.57, 95% CI: 1.52 to 8.41, p=0.0066), highlighting the compounded risk of multiple substance use (Tewachew et al., 2020) [15].

Healthy diet practices were also significantly associated with OI development, with those not eating healthy being at a higher risk (OR=8.46, 95% CI: 3.56 to 20.53, p<0.0001). This emphasizes the importance of nutritional support in managing HIV. Lastly, having multiple sexual partners was associated with a higher risk of OIs (OR=3.33, 95% CI: 1.27 to 9.26, p=0.0250), which may be due to increased exposure to various pathogens.

4.4. Types and Prevalence of Opportunistic Infections Among HIV-Positive Patients

The prevalence of opportunistic infections (OIs) among the HIV-positive patients in this study was 15.09%, with pulmonary tuberculosis (TB) being the most common OI, affecting 75% of the patients with OIs. Extrapulmonary TB and herpes zoster were also observed, accounting for 18.75% and 6.25% of the OI cases, respectively.

The observed prevalence of OIs in this study is consistent with findings from other regions. For instance, a study conducted in Ethiopia reported a similar OI prevalence of 16.3% among HIV-positive patients on antiretroviral therapy (ART). This similarity underscores the persistent burden of OIs in HIV-positive populations, despite the availability of ART.

Pulmonary TB's predominance among OIs aligns with global trends, where TB remains a leading cause of morbidity and mortality in HIV-positive individuals. The high prevalence of pulmonary TB in this study (75%) is comparable to findings from a study in Nigeria, which reported TB as the most common OI, affecting 70% of HIV-positive patients with OIs. This highlights the critical need for robust TB screening and treatment programs within HIV care settings.

Extrapulmonary TB, although less common than pulmonary TB, still represents a significant portion of OI cases (18.75%). This is consistent with findings from a study in India, where extrapulmonary TB accounted for 20% of TB cases among HIV-positive patients. The presence of extrapulmonary TB emphasizes the importance of comprehensive diagnostic approaches to detect and manage all forms of TB in HIV-positive individuals.

Herpes zoster, identified in 6.25% of the patients with OIs, is a less frequent but notable OI. This finding is in line with a study from South Africa, which reported a herpes zoster prevalence of 5% among HIV-positive patients. The occurrence of herpes zoster highlights the need for vigilant monitoring and timely intervention to manage viral infections in this population.

Overall, the findings of this study underscore the ongoing challenge of managing OIs among HIV-positive patients. The high prevalence of TB, both pulmonary and extrapulmonary, calls for enhanced TB control measures, including routine screening, early diagnosis, and effective treatment. Additionally, the presence of herpes zoster and other OIs necessitates a comprehensive approach to HIV care that addresses a broad spectrum of potential infections.

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These findings underscore the significant burden of TB, particularly pulmonary TB, among HIV-positive individuals. The high prevalence of TB highlights the need for targeted screening and treatment strategies to manage and prevent OIs in this population. Additionally, the presence of herpes zoster, although less common, indicates the necessity for comprehensive care approaches that address a range of potential infections.

5. Implications of These Findings

The findings of this study have several important implications for public health, clinical practice, and future research. The higher prevalence of HIV among females suggests the need for gender-specific interventions. Programs focusing on women's health, education, and empowerment could help reduce the incidence of HIV and improve health outcomes for women living with HIV. The high unemployment rate among HIV-positive individuals highlights the economic burden of the disease. Implementing employment support programs and vocational training could improve economic stability and quality of life for these patients. The significant association between substance abuse and opportunistic infections underscores the need for integrated substance abuse treatment and HIV care. Addressing substance abuse could reduce the risk of opportunistic infections and improve adherence to antiretroviral therapy. The strong link between healthy diet practices and reduced risk of opportunistic infections emphasizes the importance of nutritional support in HIV care. Providing access to nutritious food and dietary counseling should be a key component of HIV treatment programs. The low rate of condom uses among participants, especially those with multiple partners, indicates a need for enhanced sexual health education and condom distribution programs. Promoting safer sexual practices can help prevent the spread of HIV and other sexually transmitted infections.

6. Conclusions

The findings of this study highlight the complex interplay of socio-demographic, lifestyle, and clinical factors in the health outcomes of HIV-positive patients. Addressing these factors through comprehensive care strategies, including substance abuse treatment, nutritional support, and safer sexual practices, is essential for improving the quality of life and health outcomes for individuals living with HIV. An effective approach to address these challenges requires a multi-disciplinary approach, involving healthcare providers, policymakers, community organizations, and international partners. By working together, it is possible to overcome these barriers and improve the health outcomes for individuals living with HIV

Author Contributions: SK: Collected the data, trained on the research for a degree, and developed a spreadsheet for the data set. **DTA:** Developed the Research concept, supervised the student on the project, analyzed the data, and developed and fine tuned the manuscript

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Postgraduate Education, Training, and Research Ethics Committee, Faculty of Medicine and Health Sciences, Walter Sisulu University (protocol code 124/2023, dated 09:09:2024).

Informed Consent Statement: Informed consent for this study was not obtained from the subjects involved in the study because the research involves no risk to the subjects, the primary data was collected for purposes of patient management and not for research and was de-identified to reduce the risk to privacy.

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Data Availability Statement: The data that support the findings of this study are not publicly available due to privacy and ethical restrictions. The data contains sensitive information that could compromise the privacy of research participants. As such, access to these data is restricted and can only be provided upon reasonable request to the corresponding author, subject to approval by the relevant ethics review board.

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Conflicts of Interest: The authors declare no conflicts of interest from any quarters. The study was not funded, it was purely the authors' initiative to research an issue that is under-researched within the province.

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