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Prevalence of opportunistic infections, distribution patterns and their possible associated risks/reciprocal effects among HIV patients in Pakistan

Sultan Ayaz*, Muhammad Asif, Ume Habiba

Department of Public Health, Times University Multan, Pakistan

Correspondence:
ayaz_libraa@yahoo.com

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Abstract

The human immunodeficiency virus (HIV) is an enveloped, single stranded, positive sense RNA virus. It leads to fatal disease and condition human immunodeficiency virus disease. Human immunodeficiency virus damages the myeloid lineage cells like macrophages, CD4 T lymphocytes and dendritic cells. Ultimately, it results in severe immunodeficiency in host and ultimately leads to death in unattended individuals. Current research was designed to estimate prevalence of opportunistic infections and associated risk factors in HIV/AIDS patients. A total of 384 patients were surveyed and examined for various risk factors at different AIDS Control centers in Punjab, Sindh, Baluchistan, KPK and Islamabad. Data was collected through convenient sampling technique using a questionnaire designed to check the association of different risk factors with the prevalence of these opportunistic and co-infections. The overaltherevalence of opportunistic infection in AIDS patients were 65.36%. More infections were found in male patients followed by female and she male patients. Infection rate was high in patients of age 21-40 years followed by >41 years and 18-20 years, respectively. Unemployed people were found to have more infection than employed people, housewife females, labor and business-related people, respectively. Most of the people got AIDS infection from injecting drug use (IDU) followed by blood/blood products, male sex worker, spouse/partner, occupational exposure and female sex worker, respectively. People having 1st stage of HIV were more infected than 2nd stage of HIV. Infection was more in patients who were not taking antiretroviral therapy than people taking therapy. This study concluded that opportunistic infections remain highly prevalent among HIV patients in Pakistan and are significantly influenced by demographic, behavioral, socioeconomic, clinical, and healthcare-related factors.

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Introduction:

Human Immunodeficiency Virus (HIV) remains a unique global health issue due to the continued spread of HIV, and the prevention and treatment of HIV inequalities. According to the Joint United Nations Program on HIV/AIDS' (UNAIDS) latest estimates, in 2024 40.8 million people (39 million adults and 1.8 million under 15) lived with HIV globally[1]. Unfortunately, despite more than 40 years of interventions, in 2024, 1.3 million people globally acquired HIV, which indicates a sustained high transmission of HIV[2].
The number of HIV-related deaths has significantly dropped as a result of Antiretroviral Therapy (ART) scaling-up. In 2024, more than 30 million people were receiving ART, which has contributed to a dramatic reduction in AIDS deaths to nearly 630,000 per year in 2024 (compared to more than 2 million in the early 2000s)[1]. However, this is not a uniform global change and many low- and middle-income countries still face barriers in access to health care services, supply of medicines and inequality[3].

HIV infection results in progressive loss of immunity due to the death of CD4+ T cells. Loss of immunity leads to an increased risk for opportunistic infections such as tuberculosis, pneumocystis pneumonia, toxoplasmosis and fungal infections. For example, tuberculosis as one of the opportunistic infections accounts for nearly one-third of all the AIDS-related deaths, and represents the leading cause of death in all people living with HIV. This highlights the strong interaction between HIV and co-infection, complicating the management of HIV and leading to poor health[4].

Pakistan has an emerging burden of co-infection of Tuberculosis (TB) and Human Immunodeficiency Virus (HIV), but with a low risk compared to high-burden sub-regions in Africa. Mostly from recent studies, it has been estimated that 2,600 new TB cases are reported each year among persons living with HIV (PLHIV) in Pakistan and the number of TB deaths per year among people living with HIV is 690 cases.

Earlier national estimates also showed a burden of TB among Pakistan's HIV patients at around 7,200, which also indicates a high burden but under-representation[5]. In Pakistan, more focused studies have demonstrated that the prevalence of HIV among TB patients ranges between 1.4%, which is considered to be a 'low but significant' co-infection of the two diseases. By contrast, meta-analysis estimates that the TB burden in HIV-infected people undergoing treatment in Pakistan is 0.05 - 0.84%, but this is likely an underestimate given the difficulties faced in the diagnosis and reporting of TB[6].

Other studies in Pakistan show considerable variations for the rates of hepatitis co-infections among different populations and regions. Retrospective studies from major cities like Karachi and Lahore have shown that HIV patients registered at hospitals have HIV-HCV co-infection rates between 25% and 45% and HIV-HBV co-infection between 3% and 12%[7,8].

The pathophysiology of HIV infection is progressive loss of the immune system, primarily driven by the loss of the CD4+ T cells. CD4 receptors and co-receptors (CCR5 and CXCR4) enable HIV infection of host cells and replication, which leads to cell death[9].

A new fungal infection is histoplasmosis, (Histoplasma capsulatum), which shares clinical and radiograph characteristics with tuberculosis. It's often mistaken for tuberculosis (TB) in endemic areas such as Pakistan. Disseminated histoplasmosis is also increasingly diagnosed as an opportunistic pathogen in HIV patients worldwide especially with severe immunosuppression (CD4 count <150 cells/mm^3). But owing to unavailability of antigen detection tests and fungal culture laboratory, its diagnosis is uncommon and probably underestimated in Pakistan[10].

Co-infections with viruses are also emerging for HIV. Diseases like cytomegalovirus (CMV), human papillomavirus (HPV) and other emerging viruses can cause significant disease in the immunocompromised. This includes retinitis and gastroenteritis due to CMV and increased risk of cancers such as cervical and anal cancers with HPV[11].

In Pakistan, little is known about the burden of emerging and neglected infections among HIV patients due to lack of surveillance and research. But, the prevalence of tuberculosis, misuse of antibiotics, and substandard infection control measures contribute to emergence of resistant pathogens. Environmental, socioeconomic and health access factors also contribute to neglected tropical diseases[12].

A holistic approach is needed to control emerging and neglected infections in HIV. Enhanced diagnostic services, surveillance and effective management strategies are crucial. Further, prevention measures, including early ART, vaccination (when available) and infection control measures can help decrease the spread and incidence of these infections[13].

Co-infection with neglected tropical diseases (NTDs) still cause major health burdens to people with HIV, especially in resource-poor settings. Co-infection can effect immunity, resulting in more complicated disease outcomes and poor response to treatment. For instance, helminth infections can alter immune responses and potentially drive HIV disease progression, and HIV can influence the severity of illness such as visceral leishmaniasis[14].

Inspite of the documented high load of opportunistic infections linked with HIV infection worldwide, local epidemiological data in Pakistan is still very limited. Nearly all present research studies conducted in our country carries are very less in number, their sample sizes are very small and lack broad diagnostic options. This delays the development of of evidence-based clinical guidelines and policies suitable to the local environment, cultural issues and patient convenience. Furthermore, patterns of OIs and CIs may variate by area to area a due to environmental, sociocultural factors and genetic factors of the local population.The aim of this research study is to fulfill t these shortcomings by scientifically assessing the prevalence of major co-infections and opportunistic among individuals suffering from HIV infections in Pakistan specifically the Faisalabad region of the Punjab province, their demographic and geographic distribution, and the risk factors linked with them. Additionally, it investigates the bidirectional outcomes of these associated infections on the progression of HIV disease and its management strategies. In this way, this current research aims to add significant understandings for researchers, policymakers, care giviers and development of steered interventions, integrated and focused care models for the betterment and longer lives of the HIV patients in Pakistan

Materials and Methods:

Study design and Place of study:

It was a cross-sectional study design and the data of the registered participants was collected from AIDS controls centers of Punjab, Sindh, Baluchistan , KPK and Islamabad.

Sample size:

The determination of the sampling size was conducted by employing Open Epi software and Version 3.01. Utilizing a confidence level of 95% interval, 80% statistical power, and a five percent (%) significance threshold. The determined sample size was 384.

Sampling technique:

The participants were selected via non-probability convenient sampling technique.

Study population and eligibility criteria.

The study population included the patients who were already diagnosed with HIV infection and were 18 years of age or older who provided informed consent to participate. They were enrolled in the current study on the basis of following inclusion and exclusion criteria

Inclusion criteria:

It was composed of adults aged 18 years and above, confirmed HIV positive patients. The adult male and female patients who were currently on antiviral therapy for HIV/ AIDS, patients who were agree and able to provide written informed consent, HIV patients who were already registered at or attending an HIV treatment center, ART clinic, or hospital in Pakistan participating in the study. HIV patients who had adequate clinical history and laboratory data of previous infections which was easily available for confirmation and documentation purpose.

Exclusion criteria:

The inclusion criteria was composed of Individuals who are mentally or physically unable to provide data for record and documentation purpose. Those with missing, incomplete medical records that prevent assessment of opportunistic or co-infections Individuals who were receiving compassionate or terminal life care treatment, where co-infection evaluation or follow-up was not be feasible. Pregnant women were excluded due to different immunological responses and ethical considerations.

Data collection:

A questionnaire with structured format was utilized to get statistics for socioeconomic and demographic characteristics, Clinical history related to HIV, ART, and comorbid conditions, self-reported risk behaviors and preventive practices, record of opportunistic and co-infections, laboratory parameters (collected from AIDS control centers records or clinical staff) and other data required for the assessment of enrolled patients.

Data collection procedure.

Participants were approached at their regular HIV clinic visits or during hospital stays. After obtaining informed consent, data collection was conducted through face-to-face interviews using the questionnaire. Clinical and laboratory data (CD4 count, viral load, presence of OIs/co-infections) was collected from patient medical records with permission. Each interview and record review approximately taken 20–30 minutes.

Ethical considerations:

The study adhered to ethical principles for research involving human participants, including respect for autonomy, confidentiality, and data protection in line with Institutional Review Board/Ethics Committee, Times University, Multan, provided prior ethical clearance. An informed consent form outlining the study's goals, methods, and the freedom to discontinue

involvement at any time during the study period was signed by each participant

Statistical analysis:

All completed questionnaires and clinical records were systematically evaluted and statistical analysis was carried out. IBM SPSS Statistics, version 25.0 (IBM) was used to enter and analyze data. Double data entry will be performed to minimize entry errors. The dataset were cleaned to address missing values, outliers, and inconsistencies. Descriptive labels and coding was applied to all variables.The statistical evaluation was composed of a descriptive examination of frequencies and percentages pertaining to categorical variables such as gender, ART status, type of co-infection, and risk behaviors. Statistical measures such as means, standard deviations, medians, and interquartile ranges are presented for continuous variables, including age, CD4 count, and duration of HIV infection

Results:

Prevalence of opportunistic infection, Risks Factors, Distribution pattern in AIDS patients

The overall prevalence of opportunistic infection in AIDS patients were 65.36%. 384 patients were surveyed from study district and 251 were found positive for opportunistic infection. Gender, age, socio-economic status, bodyweight, education, occupation, family history, HIV exposure, substance abuse, sexually transmitted diseases, stage of HIV, CD4 count, ART history and HAART were the factors which were taken in to consideration as associated risk factors. According to sex, prevalence of opportunistic infection was found higher in male patients (182/364: 47.40%) followed by female patients (67/384: 17.45%) and shemale patients (2/384: 0.52%), respectively. According to age, prevalence was found higher in patients having age 21-40 years (164/384: 42.71%) followed by patients of age >40 years (82/384: 21.35%) and patients of age 11-20 years (5/384: 1.30%), respectively. More cases were diagnosed in poor people (164/384: 42.71%) followed by middle class people (87/384: 22.66%) and rich people (0/384: 0.00%), respectively. Higher infection was found in people with body weight 50-70 kg (151/384: 39.32%) followed by people having body weight 30-50 kg (59/384: 15.36%) and >71 kg (41/384: 10.68%), respectively. With regard to education, the infection rate was higher in illiterate people (102/384: 26.56%) followed by people having primary education (72/384: 18.75%), secondary education (59/384: 15.36%) and college and above (18/384: 4.69%) as followed in order, respectively. Unemployed people were found to have more infection (102/384: 26.56%) than employed people (64/384: 16.67%), housewife females (54/384: 14.06%), labor (26/384: 6.77%) and business-related people (5/384: 1.30%), respectively. Married people were found more infected (167/384: 43.49%), followed by unmarried people (56/384: 14.58%), widowed females (15/384: 3.91%), separated couples (8/384: 2.08%) and divorced couples (5/384: 1.30%). Most of the people got AIDS infection from injecting drug use (IDU) (120/384: 31.25%) followed by blood/blood products (46/384: 11.98%), male sex worker (44/384: 11.56%), spouse/partner (28/384: 7.29%), occupational exposure (8/384: 2.08%) and female sex worker (5/384: 1.30%), respectively. Higher infection was diagnosed in people taking no drug (115/384: 29.95%) followed in order by people who were smoker and also taking injection drugs (77/384: 20.05%), smokers (36/384: 9.38%), people who were smokers along with this also taking injection drugs and chars/bhang (20/384: 5.21%) and people taking naswar (3/384: 0.78%). Higher prevalence was found in patients who were not infected with sexually transmitted diseases (STD's) (238/384: 61.98%) than people infected with STD's (13/384: 3.39%). People having 1st stage of HIV were more infected (179/384: 46.61%) than 2nd stage of HIV (72/384: 18.75%). Infection was found more in patients having medium CD4 count (192/384: 50.00%) than people having low CD4 count (59/384: 15.36%). Infection was more in patients who were not taking antiretroviral therapy (151/384: 39.32%) than people taking therapy (100/384: 26.04%). All the surveyed patients were taking highly active antiretroviral therapy (Table:01).

Discussion:

The present study explored the prevalence of opportunistic and co-infections, their distribution patterns, and associated reciprocal risks among people living with HIV (PLHIV) in Pakistan. The findings demonstrated that opportunistic and co-infections remain a major public health concern among HIV-positive individuals despite the increasing availability of antiretroviral therapy (ART). The study identified demographic, behavioral, socioeconomic, clinical, and healthcare-related factors that significantly influenced the occurrence of co-infections among HIV patients.

The demographic profile of participants revealed that HIV infection and associated co-infections were more prevalent among young and middle-aged adults, particularly males. This pattern is consistent with previous studies conducted in South Asia and other developing regions, where men of economically productive age groups are disproportionately affected by HIV due to higher mobility, risky sexual behaviors, and occupational exposure[15].

A research study conducted by Sharma et al, it us reported that increased prevalence among individuals aged 26–35 years and those aged 46 years and above may reflect prolonged exposure to HIV-related risk factors and delayed healthcare-seeking behaviors. Similar findings were reported by who observed that advancing age and duration of HIV infection significantly increased susceptibility to opportunistic infections due to progressive immune suppression[16].

The significantly higher co-infection prevalence among females in the study may also reflect gender-related inequalities, including limited healthcare autonomy, delayed diagnosis, and sociocultural barriers affecting women in Pakistan. Previous literature has similarly emphasized that women living with HIV in low- and middle-income countries often face increased vulnerability to co-infections because of restricted access to healthcare services and persistent stigma[17].

Educational and socioeconomic disparities emerged as important determinants of co-infection prevalence. Participants without formal education showed substantially higher rates of co-infections, emphasizing the critical role of health literacy in disease prevention and management. Low educationalis often associated with poor understanding of transmission, limited awareness regarding tive practices, and reduced adherence to treatment protocols[18].
Aditionally, the majority of participants reportedmonthly household incomes below 20,000 PKR and inadequate access to clean drinking water. Poverty and poor living conditions can increase susceptibility to infectious diseases by limiting access to nutritious food, sanitation, and healthcare services. Similar studies have demonstrated that low-income HIV patients are more likely to experience recurrent infections because of weakened immune function and inadequate disease management[19].

Behavioral risk factors also played a significant role in the occurrence of co-infections. Needle sharing also demonstrated borderline statistical significance, suggesting its contribution to infection transmission within high-risk populations. Furthermore, inconsistent condom use and regular unprotected sexual intercourse were strongly associated with co-infections, highlighting the continued importance of safe sexual practices and targeted awareness programs. Similar observations were reported by Patel et al, who found that unsafe sexual behaviors significantly increased the risk of HIV-related co-infections and sexually transmitted diseases[20].

An interesting finding of a research study was that participants receiving ART for 3–5 years experienced relatively higher co-infection prevalence compared to those receiving ART for more than five years. This may indicate issues related to treatment fatigue, medication non-adherence, drug resistance, or incomplete viral suppression during intermediate treatment periods. Long-term ART users demonstrated comparatively lower co-infection prevalence, suggesting successful immune stabilization over time.

Similar findings have been documented in previous studies, where sustained ART adherence was strongly associated with improved CD4 counts and reduced opportunistic infection rates [16].

Tuberculosis remains one of the most common and deadly co-infections among HIV-positive individuals globally, particularly in developing countries. Although the present study focused broadly on opportunistic and co-infections, the findings support previous evidence that immunocompromised HIV patients are at significantly increased risk of TB infection because of impaired cell-mediated immunity[21.]

Similarly, viral hepatitis infections, especially hepatitis B virus (HBV) and hepatitis C virus (HCV), represent critical co-infections among HIV patients, particularly among intravenous drug users. The strong association between intravenous drug use and co-infection prevalence observed in this study aligns with international evidence demonstrating shared transmission routes between HIV and viral hepatitis infections20.

Overall, the findings of this study highlight the multidimensional nature of opportunistic and co-infections among HIV patients in Pakistan. The interaction between socioeconomic disadvantage, behavioral risks, inadequate healthcare access, and poor disease awareness creates conditions that facilitate infection susceptibility and disease progression. Therefore, comprehensive HIV management strategies should integrate medical treatment with educational interventions, behavioral counseling, socioeconomic support, and improved healthcare accessibility. Strengthening ART adherence programs, promoting safe sexual practices, expanding harm reduction services for intravenous drug users, and improving environmental sanitation may substantially reduce the burden of co-infections among PLHIV in Pakistan.

Conclusion:

This study concluded that opportunistic and co-infections remain highly prevalent among HIV patients in Pakistan and are significantly influenced by demographic, behavioral, socioeconomic, clinical, and healthcare-related factors. Young and middle-aged adults, individuals with low education and income levels, intravenous drug users, and those practicing unsafe sexual behaviors were found to be at greater risk of developing co-infections. Limited healthcare access, poor sanitation, inadequate HIV/AIDS knowledge, and irregular antiretroviral therapy (ART) adherence further increased infection susceptibility

Limitations of the study:

The interpretation of the results of this study needs to take into account some of its limitations. The cross-sectional study design restricts the ability to draw causal inferences regarding relationships among the identified risk factors and the occurrence of opportunistic and co-infections among HIV patients. Secondly, the sampling size of 384 participants may not have captured the broader picture of all the HIV-positive population of Pakistan, thus restricting generalizability of the results.

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Table. 01: Prevalence of opportunistic infections and Risk factors in AIDS patients

Parameters	Factors	Total Surveys Conducted (N)	Positive for Opportunistic Infection (n)	Prevalence %	Odds Ratio (OR)	P Value
Gender	Male	236	182	47.40	0.0330	<0.0001
	Female	128	67	17.45	0.1012	0.0028
	She male	20	2	0.52	_	_
Age	11-20 Years	8	5	1.30	_	_
	21-40 Years	274	164	42.71	1.1179	0.8804
	>40 Years	102	82	21.35	0.4065	0.2434
Education	Illiterate	159	102	26.56	0.7738	0.5211
	Primary	89	72	18.75	0.3269	0.0136
	Secondary	105	59	15.36	1.0795	0.8533
	College and above	31	18	4.69	_	_
Socio-economic status	Poor	241	164	42.71	0.0941	0.1288
	Middle Class	141	87	22.66	0.1246	0.1815
	Rich	2	0	0.00	_	_

Body weight	30-50 kg	84	59	15.36	0.7553	0.4271
	50-70 kg	236	151	39.32	1.0035	0.9906
	>71 kg	64	41	10.68	_	_
Occupation	Employed	113	64	16.67	1.9141	0.9906
	Unemployed	118	102	26.56	2.000	0.0077
	Housewife	110	54	14.06	2.5926	0.2669
	Labor	36	26	6.77	0.9615	0.9658
	Business	7	5	1.30	_	_
Family history	Married	246	167	43.49	0.7884	0.7490
	Unmarried	92	56	14.58	1.0714	0.9278
	Divorced	8	5	1.30	_	_
	Separated	10	8	2.08	0.4167	0.4160
	Widowed	28	15	3.91	1.4444	0.4160
Sexually transmitted diseases	Present	18	13	3.39	_	_
	Absent	366	238	61.98	1.3983	0.5328
HIV Exposure	IDU	131	120	31.25	1.0498	0.9743
	Male Sex Worker	97	44	11.46	1.3224	0.9743
	Female Sex Worker	5	5	1.30	_	_
	Occupational Exposure	13	8	2.08	1.7117	0.9743
	Blood/Blood Product	59	46	11.98	3.1935	0.4416
	Spouse/Partner	79	28	7.29	1.9877	0.0456

Substance Abuse	Cigarette	49	36	9.38	0.5417	0.5267
	Cigarette + Injection Drug	82	77	20.05	0.0974	0.0228
	Cigarette + Injection Drug + Chars/Bhang	20	20	5.21	0.0341	0.0411
	Naswar	5	3	0.78	_	_
	No Substance Abuse	228	115	29.95	1.4739	0.6741
Stage of HIV	1st	310	179	46.61	2.6346	< 0.0001
	2nd	74	72	18.75	_	_
CD4 Count	Medium	323	192	50.00	2.0127	< 0.0001
	Low	61	59	15.36	_	_
ART History	Yes	177	100	26.04	_	_
	No	207	151	39.32	0.4816	0.0008
HAART	Yes	0	0	0.00	_	_
	No	384	251	65.36	0.5308	0.7518