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Prevalence of non-communicable diseases among people living with HIV aged ≥50 years in a tertiary care hospital in India

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Abstract
Background: With the widespread use of antiretroviral therapy (ART), people living with HIV (PLHIV) are living longer, resulting in an increasing proportion of individuals aged ≥50 years. This aging population is at a higher risk of developing non-communicable diseases and multiple co-morbidities.
Objective: To assess the prevalence of co-morbidities and their association with demographic, clinical, and treatment-related factors among PLHIV aged ≥50 years.
Methods: This observational cross-sectional study included 500 HIV-positive patients aged ≥50 years attending a tertiary care ART centre. Data on demographic characteristics, clinical profile, laboratory parameters, and treatment history were collected and analyzed using appropriate statistical methods.
Results and Discussion: Diabetes mellitus and hypertension were the most prevalent co-morbidities. Females showed a higher prevalence of diabetes and ischemic heart disease, while males had higher rates of tuberculosis, dyslipidaemia, and renal dysfunction. Males also demonstrated poorer glycemic control, whereas females showed better treatment uptake and adherence. Longer duration of HIV infection and ART exposure was significantly associated with an increased burden of co-morbidities.
Conclusion: The study highlights a substantial burden of co-morbidities among older PLHIV. Integration of routine screening, early diagnosis, and comprehensive management of non-communicable diseases into HIV care, along with gender-sensitive approaches, is essential to improve long-term health outcomes.

Keywords: HIV, aging, co-morbidities, antiretroviral therapy, diabetes mellitus, hypertension, dyslipidaemia, PLHIV

Introduction
Human immunodeficiency virus (HIV) is a lentivirus belonging to the retrovirus family that infects human immune cells, leading to progressive immune system deterioration. Over time, untreated infection results in acquired immunodeficiency syndrome (AIDS), a condition characterized by severe immunosuppression, making individuals susceptible to opportunistic infections, malignancies, and multiple co-morbidities.
Despite significant advancements in prevention and treatment, HIV infection continues to be a major global public health concern. The widespread availability and increased uptake of highly active antiretroviral therapy (ART) have substantially reduced HIV-related mortality and improved life expectancy among people living with HIV (PLHIV). As a result, HIV has transitioned from an acute fatal illness to a manageable chronic disease [1–3].
Consequently, there has been a notable rise in the population of PLHIV aged 50 years and above (PLHIV50+). This group includes individuals who acquired HIV at a younger age and survived into older age due to ART, as well as those newly diagnosed after the age of 50. Aging in PLHIV is associated with a higher burden of chronic non-communicable diseases (NCDs), including hypertension, diabetes mellitus, cardiovascular diseases, dyslipidaemia, obesity, and thyroid dysfunction [4,5].
The increased prevalence of co-morbidities among older PLHIV is multifactorial, resulting from the combined effects of aging, prolonged exposure to ART, persistent immune activation, chronic inflammation, and a higher prevalence of traditional risk factors such as sedentary lifestyle, obesity, and smoking. Among these, hypertension and diabetes mellitus are the most commonly reported conditions.
Gender differences have also been observed, with women more likely to report NCDs than men, possibly due to differences in health-seeking behavior, physical activity levels, and obesity prevalence. Major determinants contributing to co-morbidities in PLHIV include advancing age, degree of immunosuppression, longer duration of ART exposure, overweight/obesity, and socio-economic factors [6–8].
In addition to chronic diseases, PLHIV are at an increased risk of opportunistic infections due to compromised immunity. The level of immunosuppression is commonly assessed using CD4 T-cell counts and viral load measurements, which are essential for monitoring disease progression and guiding treatment. Lower CD4 counts are associated with a higher risk of opportunistic infections such as tuberculosis, candidiasis, and pneumocystis pneumonia [9–11].
Furthermore, PLHIV are predisposed to other conditions such as anemia, malignancies, adverse drug reactions, and ART-related toxicities. This underscores the importance of routine screening, early diagnosis, and effective

management of co-morbidities as an integral component of HIV care.

For the purpose of classification in this study, co-morbidities are defined using standard criteria:

- **Hypertension:** Blood pressure ≥140/90 mmHg or current use of antihypertensive medication
- **Diabetes Mellitus:** Fasting blood glucose ≥126 mg/dL, postprandial glucose ≥200 mg/dL, random blood glucose ≥200 mg/dL with symptoms, or HbA1c ≥6.5% [12,13]
- **Dyslipidaemia:** Abnormal lipid profile or previously diagnosed dyslipidaemia

Opportunistic infections are defined as infections caused by microorganisms that typically do not cause disease in immunocompetent individuals but can lead to severe illness in those with weakened immune systems. The risk and type of opportunistic infections are closely related to immune status, particularly CD4 T-cell levels [15].

In recent years, the concept of frailty has gained importance in aging PLHIV. The frailty index (FI) is a quantitative measure used to assess biological aging and vulnerability to adverse health outcomes. It is calculated as the proportion of accumulated health deficits, including diseases, symptoms, disabilities, and laboratory abnormalities.

Frailty Index (FI) = (Number of health deficits present) ÷ (Total number of health deficits measured)

Studies have demonstrated that frailty occurs earlier and is more prevalent among PLHIV compared to the general population. Frail individuals are at increased risk of falls, hospitalization, poor treatment outcomes, and functional decline [16,17].

In the Indian context, there is limited data regarding the prevalence and pattern of co-morbidities among PLHIV aged 50 years and above. Therefore, the present study aims to assess the burden of co-morbidities in middle-aged and elderly PLHIV attending a tertiary care hospital, and to evaluate gender-based differences in these conditions [18,19].

Materials and methods

Study Design and Setting

This was an observational, cross-sectional study conducted at the Antiretroviral Therapy (ART) Centre of a tertiary care teaching hospital.

Study Duration

The study was carried out over a period of 18 months.

Ethical Considerations

Prior approval was obtained from the Institutional Ethics Committee before commencement of the study. Permission for waiver of consent for retrospective data collection was granted by the Ethics Committee. However, written informed consent was obtained from all participants after explaining the study objectives and procedures in detail.

Study Population and Sample Size

A total of 500 HIV-positive patients aged 50 years and above were included in the study. Patients were enrolled irrespective of the presence or absence of co-morbidities, provided they met the inclusion criteria.

Participants were recruited from both inpatient and outpatient services of the ART Centre.

Inclusion Criteria

- HIV-positive patients aged ≥50 years
- Patients willing to provide informed consent
- Patients with or without co-morbidities
- Patients previously lost to follow-up and re-enrolled for re-initiation of ART

Exclusion Criteria

- HIV-positive patients aged <50 years
- Patients unwilling to participate in the study
- Data Collection and Screening
- Data were collected from hospital records, including outpatient (OPD) and inpatient (IPD) files, ART centre records, and patient treatment cards.

Patients were screened for the presence of co-morbidities such as:

- Hypertension
- Diabetes mellitus
- Dyslipidaemia
- Ischemic heart disease (IHD)
- Study Variables

1. Demographic Data

Age
Gender
Duration of HIV infection
Duration of ART

2. Clinical Assessment

Patients were evaluated for clinical signs, symptoms, and associated co-morbidities.

3. Laboratory Investigations

The following biochemical and hematological parameters were recorded:

- Hemoglobin (Hb)
- Complete Blood Count (CBC)
- Liver Function Tests (LFT)
- Renal Function Tests (RFT)
- Serum Electrolytes (SE)
- Fasting Blood Sugar (FBS)
- Postprandial Blood Sugar (PBS)
- Lipid Profile

Additional investigations, where available, were also recorded, including:

- Glycated hemoglobin (HbA1c)
- Thyroid Function Tests (TFT)
- Two-dimensional echocardiography (2D Echo)

These data were obtained from patient treatment records (ART cards/white cards) and hospital admission records when applicable.

4. Immunological and Virological Parameters

- CD4 T-cell count
- HIV viral load

These parameters were analyzed to assess their association with co-morbidities.

5. Opportunistic Infections

The presence of opportunistic infections was documented and analyzed in relation to:

- Age
- Duration of ART
- Immune status

Data Classification and Analysis

Patients were categorized based on the presence and type of co-morbidities. The collected data were compiled and analyzed statistically to determine the prevalence and distribution of co-morbidities among the study population and their association with demographic, clinical, immunological, and treatment-related factors.

Statistical analysis

The sample size for the study was calculated based on an estimated prevalence of 44.1%, with a 95% confidence level and a margin of error of 5%, resulting in a minimum required sample size of approximately 442 participants. To enhance the reliability of the study and account for potential incomplete data, a total of 500 HIV-positive patients aged 50 years and above were included.

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics (version 25.0, Chicago, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation or median with interquartile range, depending on data distribution. Normality of data was assessed using the Shapiro–Wilk test. Appropriate statistical tests were applied, including the independent t-test or Mann–Whitney U test for quantitative variables and the Chi-square test or Fisher's exact test for qualitative variables. A p-value of <0.05 was considered statistically significant.

Results and observation

Study Population

This study included 500 HIV-positive individuals aged 50 years and above attending a tertiary care teaching hospital. The study population consisted of an equal distribution of males and females, with 250 participants in each group, ensuring balanced gender representation.

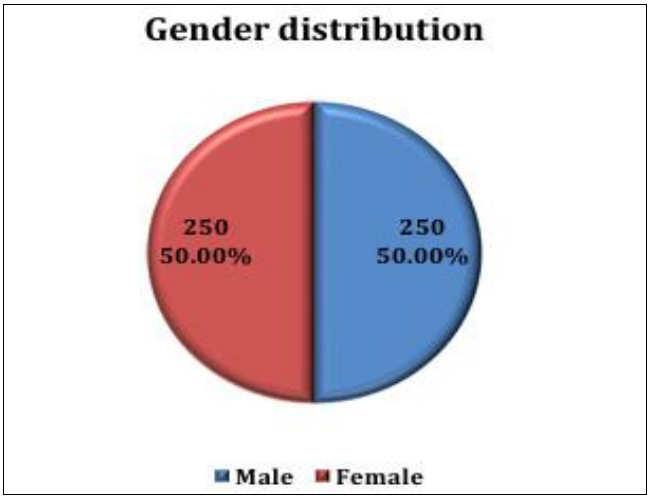

Fig 1: Gender distribution

Age Distribution

The majority of participants were within the age group of 50–55 years, followed by 56–60 years and 61–65 years, with only a small proportion above 65 years of age. The mean age of the study population was approximately 56 years. There was no statistically significant difference in age distribution between males and females, indicating that both groups were comparable with respect to age.

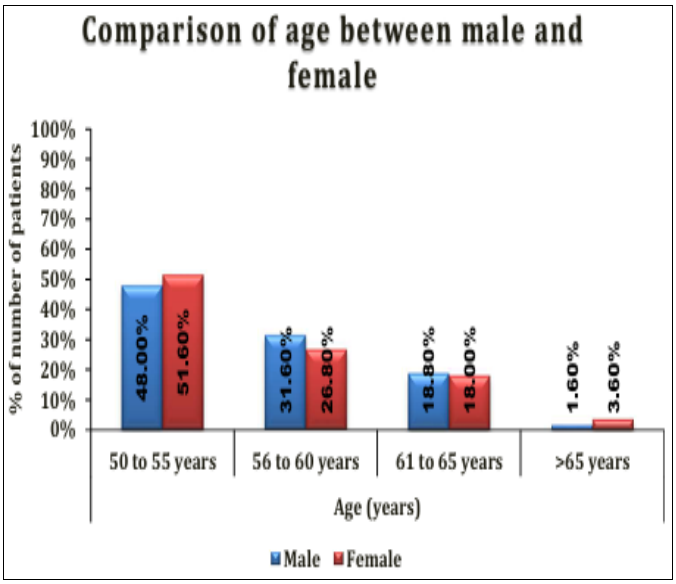

Fig 2: Comparison of age between male and female

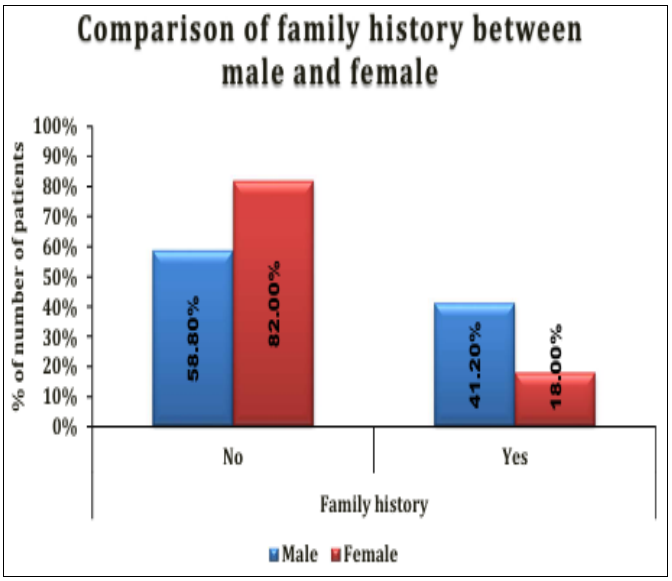

Fig 3: Comparison of family history between male and female

Family History

A significantly higher proportion of males reported a positive family history compared to females. In contrast, females had a greater proportion of individuals without any family history. This difference was statistically significant, suggesting potential gender-related differences in familial or genetic predisposition.

Prevalence of Co-morbidities

Non-communicable diseases were commonly observed among the study population. Diabetes mellitus and hypertension were the most prevalent co-morbidities,

followed by dyslipidaemia and ischemic heart disease (IHD). Females demonstrated a significantly higher prevalence of diabetes mellitus and IHD compared to males. However, the prevalence of hypertension and dyslipidaemia was similar between the two groups. Males showed a slightly higher proportion of other co-morbid conditions.

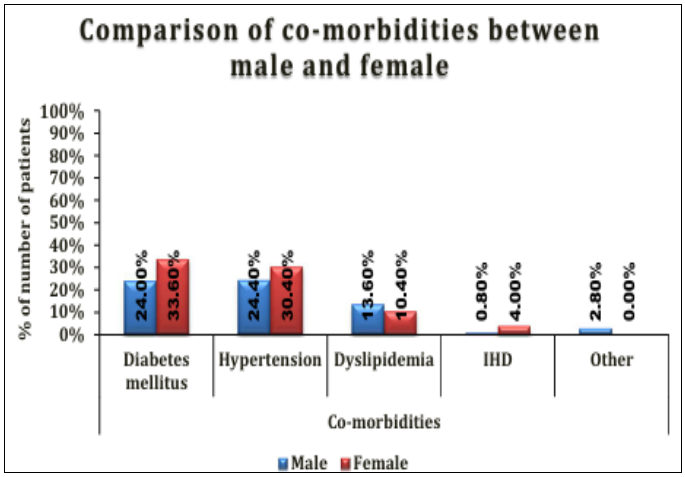

Fig 4: Comparison of co-morbidities between male and female

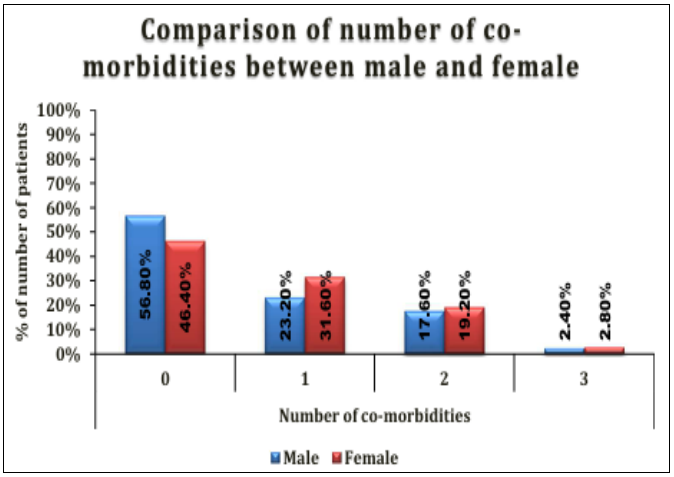

Fig 5: Comparison of number of co-morbidities between male and female

Other Co-morbid Conditions

Less common conditions such as asthma, cerebrovascular accidents (CVA), and additional cases of ischemic heart disease were observed predominantly among male participants. However, these differences were not statistically significant, and the overall prevalence of these conditions was low.

Burden of Co-morbidities

More than half of the participants did not have any co-morbidities, while a considerable proportion had one or two co-morbid conditions. Only a small fraction of patients had three co-morbidities. The distribution of the number of co-morbidities did not differ significantly between males and females.

Tuberculosis Infection

Tuberculosis was identified in a subset of the study population and was significantly more prevalent among males compared to females. This finding indicates a possible higher exposure risk or vulnerability among male patients.

Table 1: Comparison of chief complaints between male and female

Chief Complaints	Male(n=250)	Female(n=250)	Total	P value
Fever	55 (22%)	89 (35.60%)	144 (28.80%)	0.0008†
Weight loss	56 (22.40%)	102 (40.80%)	158 (31.60%)	<.0001†
Fatigue	54 (21.60%)	137 (54.80%)	191 (38.20%)	<.0001†
Chest pain	23 (9.20%)	0 (0%)	23 (4.60%)	<.0001*
Palpitation	20 (8%)	16 (6.40%)	36 (7.20%)	0.489†
Headache	18 (7.20%)	12 (4.80%)	30 (6%)	0.259†
Polyuria	18 (7.20%)	18 (7.20%)	36 (7.20%)	1†
Oral ulcers	14 (5.60%)	15 (6%)	29 (5.80%)	0.848†
Cough	65 (26%)	64 (25.60%)	129 (25.80%)	0.919†
Breathlessness	16 (6.40%)	34 (13.60%)	50 (10%)	0.007†
Nausea	18 (7.20%)	11 (4.40%)	29 (5.80%)	0.18†
Vomiting	12 (4.80%)	6 (2.40%)	18 (3.60%)	0.15†
Diarrhea	19 (7.60%)	9 (3.60%)	28 (5.60%)	0.052†

Fisher's exact test, † Chi square test

Clinical Presentation

The most frequently reported symptoms were fatigue, weight loss, fever, and cough. Females reported significantly higher proportions of systemic symptoms such as fever, weight loss, and fatigue. In contrast, males more commonly presented with chest pain and breathlessness. Other symptoms, including palpitation, headache, polyuria, oral ulcers, nausea, vomiting, and diarrhea, were similarly distributed between males and females, with no statistically significant differences.

Duration of HIV Infection and ART Exposure

The majority of study participants had a duration of HIV infection and treatment exceeding five years, indicating long-term survival on antiretroviral therapy. Males had a significantly higher proportion of patients with both shorter duration (1 month to 1 year) and longer duration (>5 years) of HIV infection and treatment, whereas females had a higher proportion in the intermediate duration group (1 to 5 years). This difference was statistically significant, suggesting variation in treatment timelines between genders.

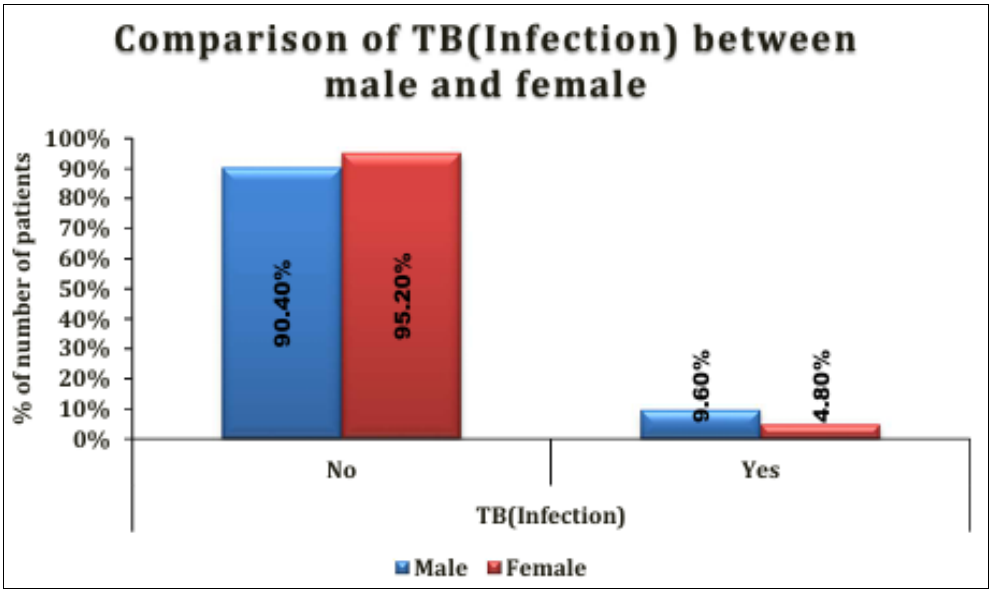

Fig 6: Comparison of TB (Infection) between male and female

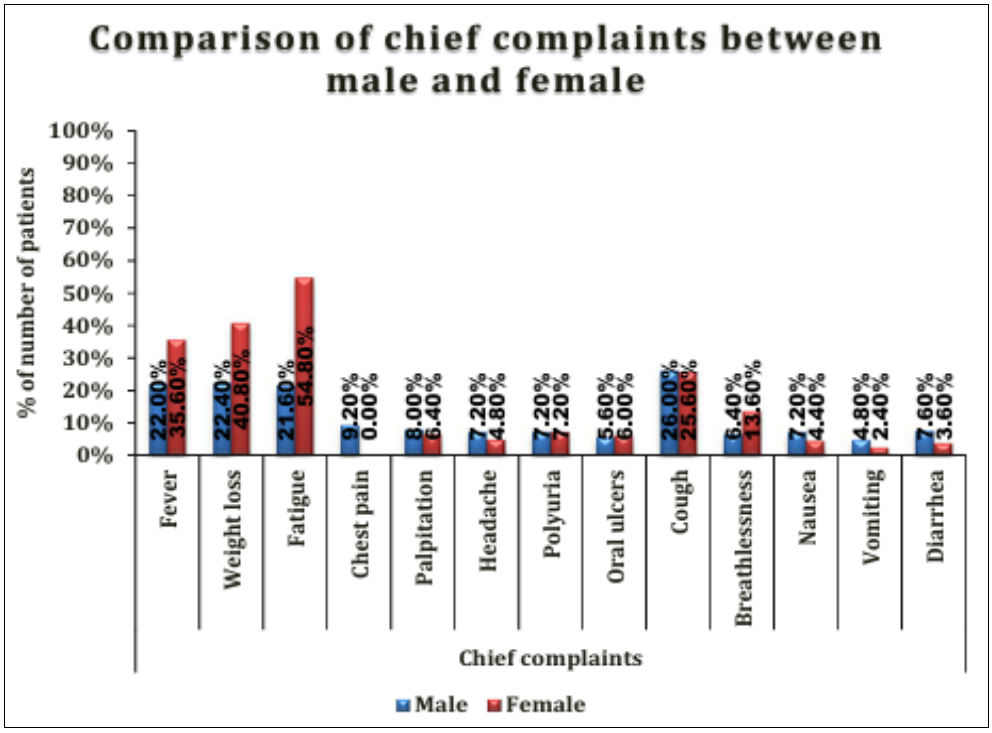

Fig 7: Comparison of chief complaints between male and female

ART Regimen Distribution

The most commonly used ART regimen among participants was the TLD regimen, followed by ALD, while a smaller proportion were on SLN. Females had a significantly higher proportion of patients on TLD regimen, whereas males had relatively higher usage of ALD and SLN regimens. This difference in ART regimen distribution between genders was statistically significant.

Changes in ART and Reasons

A majority of patients did not require any change in their ART regimen; however, females had a significantly higher proportion of patients who underwent ART modification compared to males. Among the reasons for change in ART, transitional protocols were the most common in both groups. Acute kidney injury (AKI) was reported only among females, whereas increased serum creatinine was more commonly observed in males as a reason for ART modification. These differences were statistically significant and highlight gender-based variations in treatment-related complications.

Active Tuberculosis

Active tuberculosis was observed in a subset of patients and was significantly more prevalent among males compared to females. This indicates a higher burden of active infection among male PLHIV in this study population.

Opportunistic Infections

Candidiasis was the most commonly observed opportunistic infection, with similar distribution between males and females. Other opportunistic infections such as anemia, esophageal candidiasis, oral candidiasis, and pulmonary tuberculosis were infrequent and showed no statistically

significant gender differences. Notably, no cases of Pneumocystis pneumonia (PCP), herpes zoster, or cytomegalovirus (CMV) infection were reported in the study population.

Vital Parameters
Assessment of vital parameters revealed that systolic and diastolic blood pressure values were comparable between males and females, with no statistically significant difference. However, pulse rate was significantly higher among females compared to males, indicating a notable variation in this parameter between genders.

Hypertension Status
The prevalence of current hypertension was similar between males and females, with no statistically significant difference observed. The majority of participants in both groups were non-hypertensive at the time of assessment.

Hemoglobin Status
Anemia was observed in over one-third of the study population. Although males had a slightly higher proportion of anemia compared to females, this difference was not statistically significant. Mean hemoglobin levels were also comparable between the two groups.

Renal Function (Serum Creatinine)
A significantly higher proportion of males had deranged serum creatinine levels compared to females, indicating a greater burden of renal impairment among male participants. Mean serum creatinine levels were also significantly higher in males, suggesting a potential association between gender and renal dysfunction in PLHIV.

Glycemic Parameters
Glycemic indices, including fasting blood sugar, random blood sugar, and HbA1c levels, were significantly higher among males compared to females. These findings indicate poorer glycemic control in male participants and suggest a higher metabolic risk profile in this group.

Current Diabetes Status
The prevalence of diabetes mellitus was significantly higher among males compared to females. This finding aligns with the observed differences in glycemic parameters and highlights a higher burden of diabetes in male PLHIV.

Lipid Profile and Dyslipidaemia
Total cholesterol levels were comparable between males and females. However, triglyceride levels were significantly higher among males, indicating a higher risk of dyslipidaemia in this group. Correspondingly, the prevalence of dyslipidaemia was significantly greater among males compared to females.

Liver Function Tests
Evaluation of liver function revealed that females had a higher proportion of deranged SGOT levels compared to males, whereas SGPT levels were comparable between the two groups. Despite these differences in distribution, mean enzyme levels did not differ significantly between males and females.

Table 2: Comparison of Demographic, Clinical, and Laboratory Parameters between Male and Female PLHIV Aged ≥50 Years

Parameter	Male (n=250)	Female (n=250)	Total / Observation	P value / Significance
Age (Mean ± SD)	56.41 ± 4.5	56.06 ± 4.74	Comparable	Not significant
Family History Present	41.2%	18%	Higher in males	Significant
Diabetes Mellitus	24%	33.6%	Higher in females	Significant
Hypertension	24.4%	30.4%	Comparable	Not significant
Dyslipidaemia	13.6%	10.4%	Comparable	Not significant
Ischemic Heart Disease (IHD)	0.8%	4%	Higher in females	Significant
Other Co-morbidities	2.8%	0%	Higher in males	Significant
≥1 Co-morbidity	~43.2%	~53.6%	Comparable distribution	Not significant
Tuberculosis (TB)	9.6%	4.8%	Higher in males	Significant
Active TB	14%	8%	Higher in males	Significant
Duration >5 years (HIV/ART)	96.4%	91.2%	Higher in males	Significant
ART Regimen (TLD)	74.8%	82.4%	Higher in females	Significant
Change in ART	24.8%	41.2%	Higher in females	Significant
Pulse Rate (Mean)	Lower	Higher	Higher in females	Significant
Blood Pressure (SBP/DBP)	Comparable	Comparable	No difference	Not significant
Current Hypertension	19.6%	21.2%	Comparable	Not significant
Anemia	40.4%	32.8%	Comparable	Not significant
Serum Creatinine (Deranged)	10%	0%	Higher in males	Significant
Fasting Blood Sugar	Higher	Lower	Higher in males	Significant
Random Blood Sugar	Higher	Lower	Higher in males	Significant
HbA1c	Higher	Lower	Higher in males	Significant
Current Diabetes Status	42.8%	32%	Higher in males	Significant
Cholesterol	Comparable	Comparable	No difference	Not significant
Triglycerides	Higher	Lower	Higher in males	Significant
Dyslipidaemia (Current)	52.55%	42.41%	Higher in males	Significant
SGOT (Deranged)	21.6%	37.2%	Higher in females	Significant
SGPT (Deranged)	Comparable	Comparable	No difference	Not significant
Opportunistic Infections	Comparable	Comparable	No major difference	Not significant

Treatment Patterns and Disease Control among PLHIV

The present study demonstrated significant gender-based differences in treatment uptake and disease control among older people living with HIV. Females were more likely to receive treatment for both diabetes mellitus and hypertension compared to males, indicating better healthcare-seeking behavior and adherence among women. In contrast, a considerable proportion of male patients remained untreated for these conditions, highlighting a gap in healthcare utilization. Despite lower treatment uptake, males exhibited poorer glycemic control, with a significantly higher proportion of uncontrolled diabetes compared to females. Conversely, males showed better control of hypertension, whereas females had a relatively higher proportion of uncontrolled blood pressure. These findings emphasize the complex interplay between treatment adherence and disease outcomes across genders.

Newly Diagnosed Co-morbidities

The study also revealed a higher burden of newly diagnosed non-communicable diseases among males. Newly detected cases of both hypertension and diabetes mellitus were significantly more common in males compared to females, suggesting delayed diagnosis, inadequate screening, or reduced health-seeking behavior among men. However, the prevalence of newly diagnosed dyslipidaemia was comparable between genders, indicating a similar risk profile for lipid abnormalities in both groups.

Association of Co-morbidities with Age

Analysis of co-morbidities across different age groups showed no statistically significant association between advancing age and the prevalence of conditions such as diabetes mellitus, hypertension, dyslipidaemia, and ischemic heart disease. The distribution of these co-morbidities remained relatively uniform across all age categories, suggesting that factors other than age, such as duration of HIV infection and ART exposure, may play a more prominent role.

Hematological and Infectious Profile with Age

Hemoglobin status was found to be comparable across all age groups, with no significant variation in the prevalence of anemia. Similarly, the occurrence of tuberculosis infection did not differ significantly across age categories. These findings indicate that both anemia and tuberculosis in this study population were not strongly influenced by age, but may instead be related to underlying immunological status and disease progression.

Table 3: Clinical, Treatment, and Outcome Characteristics of PLHIV Aged ≥50 Years

Parameter	Male	Female	Key Observation	Significance
Diabetes Treatment	Lower treatment	Higher treatment	Females better treated	Significant
Hypertension Treatment	Lower treatment	Higher treatment	Females better treated	Significant
Diabetes Control	Poor control	Better control	Higher uncontrolled DM in males	Significant
Hypertension Control	Better control	Poorer control	Males better BP control	Significant
Newly Diagnosed Hypertension	Higher	Lower	Higher undiagnosed HTN in males	Significant
Newly Diagnosed Diabetes	Higher	Lower	Higher undiagnosed DM in males	Significant
Newly Diagnosed Dyslipidaemia	Comparable	Comparable	No gender difference	Not significant
Co-morbidities vs Age	Comparable	Comparable	No age association	Not significant
Hemoglobin vs Age	Comparable	Comparable	No age association	Not significant
TB vs Age	Comparable	Comparable	No age association	Not significant

Association of Co-morbidities with Age, Duration, and Treatment Factors

The distribution of tuberculosis infection was comparable across all age groups, with no statistically significant association observed. However, active tuberculosis showed a significant variation, being more prevalent in the younger elderly groups (50–60 years) and less common in the 61–65 years group. Opportunistic infections, including candidiasis and other minor infections, were uniformly distributed across age groups, with no significant differences observed.

When analyzed with respect to duration of HIV infection and treatment, a significant increase in co-morbidities such as diabetes mellitus and hypertension was observed in patients with longer duration (>5 years) of disease and ART exposure. In contrast, patients with shorter duration had negligible prevalence of these conditions. Hemoglobin levels also showed significant variation, with anemia being more common in early stages of disease, while non-anemic status was more frequent in patients with longer duration. However, overall TB infection remained comparable across duration groups, although active TB was significantly higher in patients with shorter duration of HIV infection.

Impact of ART Regimen and Treatment Modification

The type of ART regimen showed a strong association with co-morbidities. Patients on ALD regimen had significantly higher prevalence of diabetes mellitus, hypertension, and ischemic heart disease compared to those on TLD regimen. Dyslipidaemia was comparable across regimens. Opportunistic infections, particularly candidiasis, were more frequently observed in patients on ALD regimen. Additionally, anemia was more prevalent among patients on ALD compared to TLD regimen. Active tuberculosis was also significantly higher in patients receiving ALD regimen, indicating a possible association between ART type and disease burden.

Patients who underwent changes in ART regimen demonstrated a higher prevalence of ischemic heart disease, whereas other co-morbidities were comparable between those with and without ART modification. Interestingly, patients with ART changes had a significantly higher proportion of non-anemic status. No significant association was observed between ART modification and tuberculosis or opportunistic infections.

Association with Immunological and Virological Parameters

Analysis based on viral load demonstrated that co-morbidities such as diabetes mellitus and hypertension were significantly more prevalent in patients with detectable viral load compared to those with undetectable levels. However, hemoglobin status, tuberculosis infection, active TB, and opportunistic infections were comparable across different viral load categories.

Association with Laboratory Parameters

Anemia was significantly associated with ischemic heart disease, while non-anemic patients had a higher prevalence of diabetes mellitus. Renal dysfunction, as indicated by elevated serum creatinine, was significantly associated with higher prevalence of diabetes mellitus and hypertension, suggesting a link between metabolic disorders and renal impairment.

Patients with dyslipidaemia showed significantly higher prevalence of diabetes mellitus and hypertension, highlighting clustering of metabolic risk factors. Similarly, liver function abnormalities showed distinct associations, with deranged SGOT levels being significantly associated with higher prevalence of ischemic heart disease, while SGPT levels did not show significant associations with co-morbidities.

Table 4: Association of Co-morbidities with Clinical, Treatment, and Laboratory Parameters in PLHIV ≥50 Years

Factor	Key Finding	Observation	Significance
Age vs TB	Comparable	No association	Not significant
Age vs Active TB	Higher in 50–60 yrs	Lower in 61–65 yrs	Significant
Age vs OIs	Comparable	No difference	Not significant
Duration >5 yrs	↑ Diabetes, HTN	Higher co-morbid burden	Significant
Duration vs Anemia	Early disease → anemia	Late → non-anemic	Significant
Duration vs Active TB	Higher in early duration	Lower later	Significant
ART (ALD)	↑ DM, HTN, IHD	Higher co-morbidities	Significant
ART (TLD)	Lower co-morbidities	Protective trend	Significant
ART vs OIs	↑ candidiasis in ALD	Higher infection risk	Significant
ART Change	↑ IHD	Other co-morbidities similar	Significant (IHD only)
Viral Load	↑ DM, HTN in detectable	Worse metabolic profile	Significant
Hemoglobin vs IHD	↑ IHD in anemic	Strong association	Significant
Creatinine vs Co-morbidity	↑ DM, HTN	Renal-metabolic link	Significant
Dyslipidemia	↑ DM, HTN	Clustering of NCDs	Significant
SGOT (Deranged)	↑ IHD	Liver–cardiac link	Significant
SGPT	Comparable	No association	Not significant

Discussion

The present study included 500 PLHIV aged ≥50 years with equal gender distribution and comparable mean age, ensuring unbiased comparison of outcomes. The findings reflect the increasing population of older PLHIV due to improved survival with antiretroviral therapy (ART).

A significant association was observed between longer duration of ART and higher prevalence of co-morbidities, particularly diabetes and dyslipidaemia. Hypertension and diabetes were the most common co-morbidities, with females showing a higher prevalence of diabetes and ischemic heart disease, while hypertension and dyslipidaemia were comparable between genders. Women demonstrated better treatment uptake and control, whereas men had poorer control despite lower prevalence.

Dyslipidaemia and cardiovascular risk were more prominent among males, likely related to long-term ART effects. Opportunistic infections, especially tuberculosis, were more common in males and associated with lower CD4 counts, highlighting ongoing immune vulnerability.

Although CD4 counts were comparable between genders, males showed better viral load suppression. Anemia was prevalent in a significant proportion of patients, while renal and liver function abnormalities were more common in males, indicating the impact of long-term ART. Overall, the study highlights a high burden of co-morbidities among aging PLHIV and emphasizes the need for integrated, gender-sensitive care with regular screening and monitoring to improve outcomes.

Conclusion

The present study highlights the substantial burden of co-morbidities among people living with HIV (PLHIV) aged 50 years and above, reflecting the shifting epidemiology of HIV in the era of effective antiretroviral therapy (ART). With improved survival, HIV has evolved into a chronic condition, accompanied by an increased prevalence of non-communicable diseases such as diabetes, hypertension, dyslipidaemia, and cardiovascular disorders. These findings underscore the need to reorient HIV care toward a more comprehensive and holistic approach.

The study emphasizes the importance of integrated care models that simultaneously address HIV management and age-related co-morbidities. Early detection, routine screening, and timely intervention for chronic conditions, along with continuous monitoring of immunological and virological parameters, are essential to improve long-term outcomes. Additionally, regular assessment of organ function and metabolic status is crucial in patients on prolonged ART to minimize treatment-related complications.

An important observation is the presence of gender-based differences in disease prevalence, treatment uptake, and outcomes, indicating the need for gender-sensitive healthcare strategies. Tailored interventions focusing on improving treatment adherence and disease control, particularly among men, can enhance overall health outcomes.

The concept of frailty is emerging as a significant concern in aging PLHIV, given its association with multimorbidity and adverse clinical outcomes. Although not directly

measured in this study, the high burden of co-morbidities suggests the need for incorporating frailty assessment into routine clinical practice.

In conclusion, the findings of this study reinforce the growing need for multidisciplinary and patient-centered care in older PLHIV. Strengthening healthcare systems to incorporate routine screening for non-communicable diseases, optimizing ART regimens to reduce long-term toxicity, and implementing integrated care strategies will be critical in improving the quality of life and clinical outcomes in this vulnerable population, particularly in resource-limited settings.

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Ethical approval

Ethical clearance was obtained from the Institutional Ethics Committee, and permission for data collection was granted by Mumbai District AIDS Control Society. Patient confidentiality was strictly maintained, and no identifying information was disclosed.

Conflict of interest

The author declares that there is no conflict of interest related to this study.

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