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Prevalence of Pulmonary Tuberculosis in HIV-Infected Individuals

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ABSTRACT

Background: Tuberculosis (TB) is a significant cause of mortality among people living with HIV (PLWH), in Nepal. HIV increases the risk of progression from latent to active TB, increasing mortality. Despite established TB control programs, there is a significant lack of recent data measuring the tuberculosis burden among PLWH specially within the Western region of Nepal. This study was conducted to assess the prevalence of pulmonary tuberculosis among HIV-positive patients attending a tertiary care centre in Gandaki Province, Nepal.

Methods: A hospital-based cross-sectional study was conducted at Western Regional Hospital, Pokhara Academy of Health Sciences, from August 2025 to January 2026. First, HIV-positive patients attending the ART clinic were screened, and those aged ≥18 years without prior tuberculosis were included. Next, participants were recruited using convenience sampling. After obtaining informed consent, sociodemographic and clinical data were collected through a structured questionnaire and medical record review. Subsequently, CD4 counts were measured using the PIMA CD4 analyser, and sputum samples were examined using Ziehl–Neelsen staining for acid-fast bacilli. Finally, data were analysed using SPSS version 22, with $p < 0.05$ considered statistically significant.

Results: Prevalence of pulmonary TB was found to be 5.1% among 137 participants. TB co-infection was found to be higher among males and in the 20-29 years and >70 years age groups. TB was more common among those with CD4 counts <200 cells/μL, but was not statistically significant.

Conclusions: The study found a 5.1% prevalence of pulmonary TB among PLWH in western Nepal and highlights the need for regular TB screening.

Keywords: CD4 count; pulmonary tuberculosis Nepal; TB–HIV co-infection.

INTRODUCTION

Tuberculosis (TB), caused by *bacillus Mycobacterium tuberculosis*, is a preventable and curable disease, yet in 2023 it remained one of the leading causes of death from a single infectious agent worldwide, with over ten million new cases annually.[1] Individuals with Human Immuno-deficiency virus (HIV) infection is more likely to develop TB, have a poorer outcome of TB, and have three times higher mortality during treatment for TB than individuals without HIV infection.[2]

TB-HIV co-infection still remains underdiagnosed in many countries in the Asia-Pacific region, mainly due to inadequate coverage of HIV testing, inadequate TB testing services, and the lack of programs for integrated screening and diagnosis in the health systems.[3] About 8% of the population of people living with HIV infection are co-infected with tuberculosis, with a large number of cases being reported in low-income and middle-income countries, including Nepal, where the prevalence of TB-HIV co-infection has remained high.[4]

A 2012 study from Pokhara, Nepal suggested that there is a substantial burden of Pulmonary Tuberculosis in HIV infected individuals.[5] This study assesses the prevalence of pulmonary tuberculosis among the people living with HIV in a tertiary care hospital in Gandaki Province, Nepal.

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METHODS

A hospital-based cross-sectional study was conducted. The study was conducted at Department of Microbiology and Anti Retro Viral Therapy (ART) unit, the western Regional Hospital of Pokhara Academy of Health Sciences, Pokhara, over a period of six months from August 2025 to January 2026. Ethical approval was obtained from the institutional review committee of Pokhara Academy of Health Sciences, Pokhara, Nepal (IRC NO. 17/082; approved on 1 August 2025). Permission from ART unit was also obtained. Written informed consent was obtained from all participants prior to enrollment, and patient confidentiality was maintained. HIV-positive patients aged 18 years or older with prior TB were excluded to avoid misclassification of relapse or post treatment sequelae.

The sample size for this study was calculated using the single population proportion formula, based on a previously reported prevalence of HIV-TB co-infection of 9.9 percent from a study conducted in Nepal in 2022.[6] Assuming a 95% confidence level (Z = 1.96) and a 5% margin of error, the minimum required sample size was calculated to be 137 participants.

Convenient sampling was used, and eligible HIV-infected individuals attending the ART unit of this hospital between August 2025 to January 2026 until the required sample size was reached. CD4 cell counts were measured using the PIMA CD4 analyser. For analysis, CD4 counts were categorized as <200, 200–349, and ≥350 cells/μL. The sputum samples were examined microscopically for acid-fast bacilli using the Ziehl-Neelsen staining technique. All procedures were conducted in accordance with standard laboratory quality control and biosafety protocols.

The data was entered into Microsoft Excel and analysed using the Statistical Package for Social Sciences (SPSS) version 22. The descriptive statistics were employed to describe the sociodemographic and laboratory data of the study participants. The categorical variables were described using frequencies, percentages, bar charts, and pie charts, while the continuous variables were described using mean (standard deviation), median (interquartile range), and box and whisker plots. The association between categorical variables was determined using the chi-square test or Fisher's exact test, depending on the suitability of the test. The Mann-Whitney U test was employed to determine the differences between skewed numerical variables in two groups. A p-value of <0.05 was used to determine significance.

RESULTS

Of 137 participants, females constituted 48.2% of the study population. The mean age was 46.18 ± 14.59 years (range: 18–94 years), with the highest proportion of participants in the 50–59 years age group (28.5%), followed by those aged 40–49 years (24.1%).

Table 1. Sociodemographic characteristics of the 137 people living with HIV (PLHIV).

Variables	Categories	Frequency (n)	Percentage
Gender	Females	66	48.20
	Males	71	51.80
Age group	<20 years	3	2.20
	20-29	19	13.90
	30-39	22	16.10
	40-49	33	24.10
	50-59	39	28.50
	60-69	15	10.90
	70 and more	6	4.40
Median age (IQR)		47 (IQR,36-56)	

Proportion of tuberculosis among PLHIV (TB-HIV co-infection):

As shown in Figure 1, the proportion of tuberculosis among PLHIV was 5.1% (95% CI: 1.6-8.7).

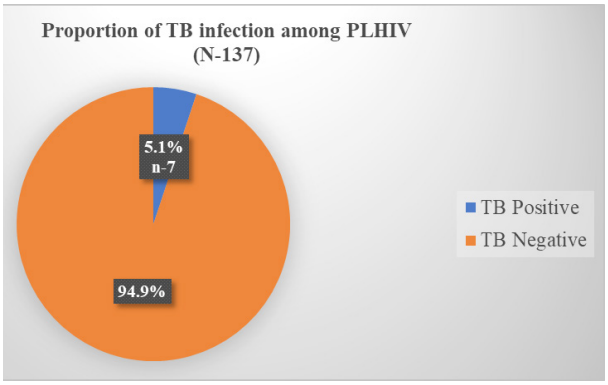

Figure 1. Tuberculosis (TB) infection among PLHIV.

HIV-TB co-infection and gender

The proportion of TB-positive cases was higher among male HIV patients (5.6%; 95% CI: 1.76-9.44) than among females (4.5%; 95% CI: 1.06–7.94) (Figure 2). Similarly, as shown in Figure 3, among the seven patients with

HIV-TB co-infection, more than half were male (57.1%; 95% CI: 20.45-93.75).

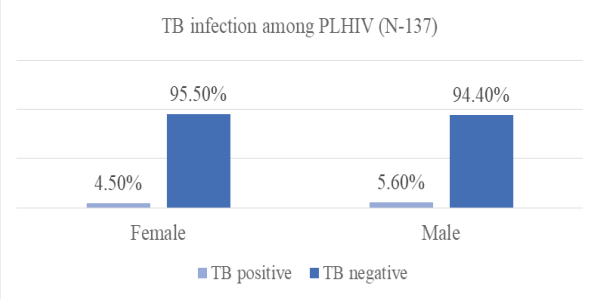

Figure 2. Distribution of tuberculosis infection status among PLHIV according to gender (row percentages).

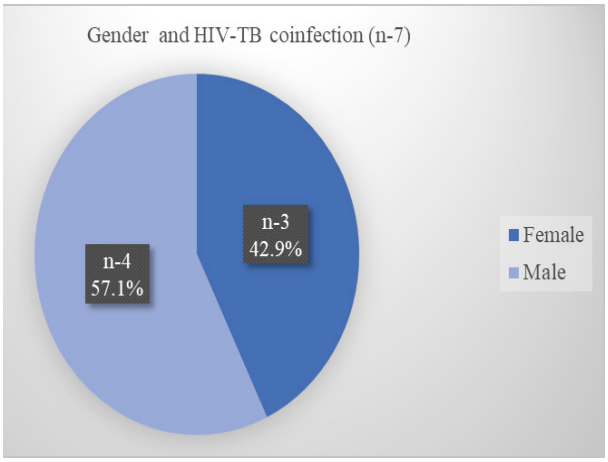

Figure 3. Gender-wise distribution of TB-positive cases among PLHIV (n = 7), presented as column percentages.

As shown in Table 2, one-fifth of the patients with HIV-TB co-infection belonged to the 20-29 years age group (21.1%), followed by those aged ≥70 years (16.7%).

Table 2. Distribution of HIV-TB co-infection according to age group. (N = 137), presented as row percentages.

Age group	Tuberculosis Positive n (%)	Tuberculosis negative n (%)	Total
<20	0	3 (100)	3
20-29	4(21.1)	15(78.9)	19
30-39	1(4.5)	21(95.5)	22
40-49	0	33(100)	33
50-59	1(2.6)	38(97.4)	39
60-69	0	15(100)	15
70 and more	1(16.7)	5(83.3)	6
Total	7	130	137

HIV-TB co-infection and CD4 status:

Figure 3 and Table 3 compare the distribution of CD4 cell counts between TB-positive and TB-negative PLHIV. As CD4 cell counts were not normally distributed, the Mann-Whitney U test was applied to assess differences between the two groups. The analysis showed no statistically significant difference (p = 0.15).

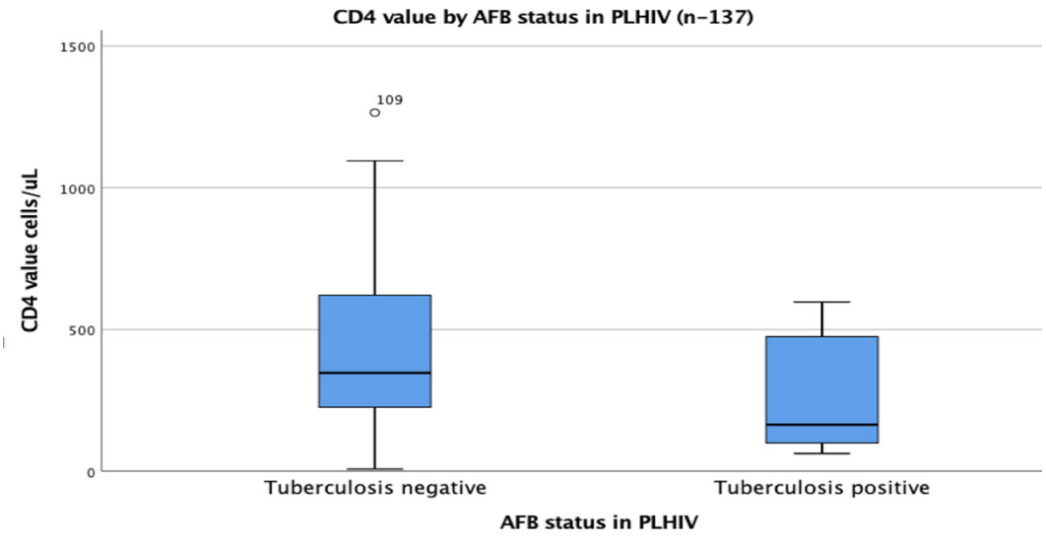

Figure 4. Box and whisker plot showing distribution of CD4 cell counts among TB positive and negative PLHIV.

Table 3. Comparison of CD4 cell counts between TB-positive and TB-negative PLHIV.

CD4 count Cells/uL	Tuberculosis Positive (n-7)	Tuberculosis Negative (n-130)	P value
Minimum	63	8	0.145
Maximum	597	1265	
Median (IQR)	164 (71-475)	347(223.50-628.25)	
Mean Rank	47.71	70.15	

P value significant <0.05

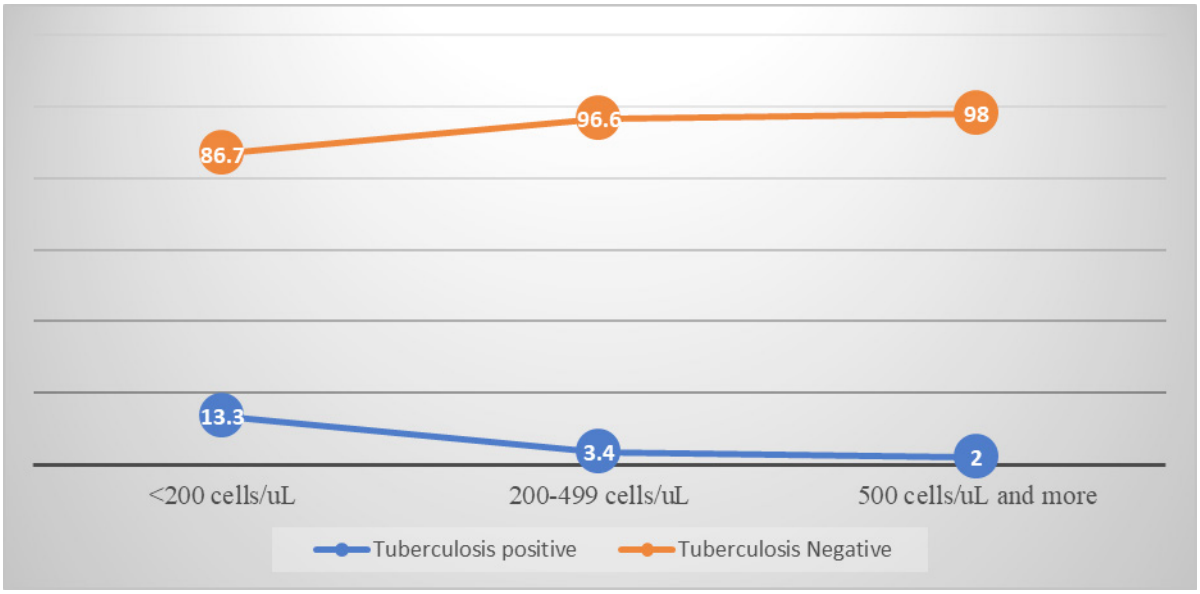

Figure 5. Proportion of HIV-TB co-infection across CD4 cell count categories.

The proportion of TB-positive cases was highest among PLHIV with CD4 counts <200 cells/μL (13.3%) and lowest among those with CD4 counts ≥500 cells/μL (2.0%).

Table 4: shows no significant association between HIV-TB co-infection and gender or CD4 cell count (p = 0.103). However, a significant association was observed between age group and HIV-TB co-infection (p = 0.030).

Table 4. Association of TB-HIV co infection with gender, age-group and CD4 count

Variable	Categories	TB Positive n (%)	TB negative n (%)	Chi-square value	p value
Gender	Female	3(4.5)	63(95.5)	0.084	1*
	Male	4(5.6)	67(94.4)		
Age-group	<30	4(18.2)	18(81.8)	7.013	0.030**
	30-59	2(2.1)	92(97.9)		
	60 and more	1(4.8)	20(95.2)		
CD4 count cell	<200	4(13.3)	26(86.7)	4.55	0.103**
	200-499	2(3.4)	56(96.6)		
	500 and more	1(2.0)	48(98.0)		

P value significant at <0.05 *Fisher's exact test ** Likelihood ratio

DISCUSSION

The prevalence of pulmonary tuberculosis in people living with HIV (PLWH) in this study was 5.1%, which is similar to the prevalence of 5.97% reported in a Pokhara-based study conducted in 2012.[5] Similarly, an inpatient study conducted in Chengdu, China from 2018 to 2022 found that HIV-positive pulmonary tuberculosis accounted for around 6.1% of all tuberculosis cases, which is similar to the prevalence of pulmonary tuberculosis among people living with HIV in our study.[7] However, unlike our study which included HIV patients, their study was conducted among tuberculosis patients. Despite this difference, the prevalence of HIV-TB coinfection was similar in both studies.

A systematic review and meta-analysis across 11 studies from various regions of Nepal reported a wide range of HIV-TB co-infection prevalence, varying from 5% to 40% with pooled prevalence of 19% [8] indicating substantial variation across the country.

Similarly, a retrospective study conducted in southern Ethiopia reported HIV-TB coinfection prevalence of 27.7% among HIV patients. This higher prevalence of HIV-TB co-infection observed in these studies compared to our findings may be attributed to their larger sample sizes, as well as difference in diagnostic methods. Many of the included studies relied on Ziehl-Neelsen stain and chest-Xray, which may have overestimated the true prevalence. Additionally, the variation in tuberculosis epidemiology between countries and within regions of same country may also partly explain this difference.[9]

In this study, the proportion of males among HIV-TB co-infected participants was higher (57.1%) compared to females. Similar patterns of male predominance have been reported in studies from South Asia, including Eastern Nepal (75.2%), central India (78.2%), Bangladesh (58%), and Pakistan (82.6%), as well as in high-income countries such as Japan (61.74%). Furthermore, a surveillance study from the United States reported that men were 2.74 times more likely to have HIV-TB co-infection than women.[10-14] The observed male predominance may be explained by behavioural and biological differences[7], as well as gender roles, which influence exposure risk and healthcare-seeking behaviour.

In contrast, studies from low-income countries such as Ethiopia have reported a higher burden of TB/HIV co-infection among females (69% and 31%) compared to males. This finding was supported by the study conducted in Ethiopia [15] that reported 85.7% of HIV-TB coinfected were females. This difference may be partly explained by the higher proportion of female participants in those studies, where more than two-thirds of the study population were females and can be attributed to biological factors, that makes them more vulnerable to HIV infection. However, in bi-variate analysis, the study conducted in Ethiopia (p=0.30)[15] and our study (p=1.0) showed no significant association between gender and

HIV-TB coinfection.

Conversely, a study from Nepal showed significant association between gender and HIV-TB coinfection (p=0.03)[6] The above finding also suggested that gender related differences in HIV-TB coinfection may vary by regions. The underlying reason of this differences need further investigation with different approach.

Contrary to the present study, which found a higher prevalence of HIV-TB co-infection among individuals aged 20–29 years (21.1%) and those aged 70 years and above (16.7%), a study from the Bundelkhand region by Jaiswal et al. reported that most co-infected cases (64.3%) occurred in the sexually active age group of 26–45 years.[16]

The higher proportion observed in the 20–29-year age group in the present study may partly be due to the age distribution of the study population, with a relatively greater representation of individuals in this age category. Furthermore, HIV-TB co-infection was more common among individuals with lower CD4 cell counts, particularly below 200 cells/μL; however, this association was not statistically significant. In a recent Indian study, nearly one-third of PLWH had active tuberculosis, and approximately 80% of those co-infected had CD4 counts below 200 cells/ μL at the time of diagnosis.[17] In contrast, several studies have reported a strong and significant association between tuberculosis and advanced immunosuppression, with a higher burden observed among patients with CD4 counts below 200 cells/μL, especially below 150 cells/μL.[18,19] A study from Nepal published in 2013 also reported that TB co-infection among HIV patients was significantly associated with lower CD4 counts before and during early antiretroviral therapy.[20]

These findings highlight the importance of routine tuberculosis screening and close monitoring of immune status among people living with HIV, which may help in early detection and timely management of TB co-infection.

Our study had several limitations. First, the findings may not be generalizable to other settings, as data were collected from a single ART centre located at the Western Regional Hospital. Second, the hospital-based cross-sectional design of the study limits the ability to draw causal inferences. Finally, the use of Ziehl-Neelsen staining for TB diagnosis may have underestimated the prevalence due to its lower sensitivity compared to GeneXpert.

CONCLUSIONS

Pulmonary tuberculosis remains a significant public health concern among people living with HIV in western Nepal. Strengthening routine TB screening, integrated TB-HIV care, and close monitoring of immunological status is essential for early detection and improved patient outcomes. Further multicentre studies are recommended to better understand regional trends and guide specific interventions.

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CONFLICT OF INTEREST

Authors declare there are no any conflicts of Interest.

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