**Original Research Article**

**PREVALENCE OF TUBERCULOSIS AMONG PERSONS WITH HUMAN IMMUNODEFICIENCY VIRUS ATTENDING MBARARA CITY COUNCIL HEALTH CENTER IV**

**ABSTRACT**

**Background:** Tuberculosis (TB) remains the leading opportunistic infection and cause of death among people living with Human Immunodeficiency Virus (HIV), especially in sub-Saharan Africa. Co-infection complicates treatment outcomes and increases disease burden. This study aimed to determine the prevalence of TB among HIV-positive individuals and identify associated risk factors at Mbarara City Council Health Center IV in Uganda.

**Methods:** A cross-sectional study was conducted among HIV-positive patients attending Mbarara City Council Health Center IV. Data were collected using structured questionnaires and clinical records, and TB diagnosis was confirmed through standard diagnostic methods. Statistical analysis was performed to determine prevalence and assess associations between TB and demographic variables.

**Results:** Out of the total respondents, 19 (17.3%) HIV-positive individuals were found to have active tuberculosis (95% CI: 0.313–0.432). TB prevalence was higher among males, individuals aged 51 years and above, children aged 15 years and below, and business persons. Male patients were 4.9 times more likely to have TB compared to females (OR = 4.91; 95% CI: 0.733–3.910; *p* = 0.001). Older adults (≥51 years) and young children were also significantly more likely to be co-infected (*p* < 0.001).

**Conclusion:** The study revealed a relatively high burden of TB among HIV-infected individuals at Mbarara City Council Health Center IV, with age, gender, and occupation being significant risk factors. These findings highlight the need for targeted TB screening, prevention, and integrated care approaches within HIV treatment programs, especially for vulnerable subgroups.

***Keywords:*** *Tuberculosis, HIV, Prevalence, Co-infection, Risk Factors, Mbarara, Uganda, Public Health*

# INTRODUCTION

Tuberculosis (TB) and Human Immunodeficiency Virus (HIV) represent two of the most devastating infectious diseases globally, with a complex and deadly interaction. TB is the leading cause of death among people living with HIV (PLHIV), accounting for approximately one-third of AIDS-related deaths worldwide. The immune suppression caused by HIV increases the susceptibility to TB infection and progression from latent to active TB disease, while TB itself accelerates the course of HIV infection. This syndemic relationship makes TB a critical co-infection to monitor and manage in HIV-positive populations. [1-4] Sub-Saharan Africa remains disproportionately affected by the dual burden of TB and HIV. According to the World Health Organization, Africa contributes over 70% of the global burden of TB/HIV co-infection. Uganda, one of the high-burden countries for both diseases, continues to report high co-infection rates, particularly in urban and peri-urban regions where population density, poverty, and health service limitations converge. Despite efforts by the Ministry of Health to integrate TB and HIV services, co-infection remains a major challenge for the healthcare system [5-8]. HIV-induced immune suppression significantly increases the risk of both primary TB infection and reactivation of latent TB. Individuals with a CD4 cell count below 200 cells/mm³ are at particularly high risk. Even among those on antiretroviral therapy (ART), the risk of TB remains elevated due to immune reconstitution inflammatory syndrome (IRIS) and incomplete immune recovery. In this context, regular TB screening, early diagnosis, and prompt treatment are essential components of comprehensive HIV care [9-12].

The diagnosis of TB in PLHIV, however, is often complicated by atypical clinical presentations and reduced sensitivity of conventional diagnostic tools such as sputum smear microscopy. The advent of rapid molecular diagnostic methods like the GeneXpert MTB/RIF assay has significantly improved the detection of TB among HIV-positive individuals by enabling simultaneous identification of *Mycobacterium tuberculosis* and rifampicin resistance. Nevertheless, limited access to diagnostic technology and clinical capacity still hampers early TB detection in many health facilities across Uganda [13]. Mbarara City, located in southwestern Uganda, is a major urban center with a high HIV burden. The Mbarara City Council Health Center IV provides HIV care and treatment services to a large population, yet the true prevalence of TB among its HIV-positive clientele has not been comprehensively documented. Understanding the extent and determinants of TB in this specific setting is essential for designing targeted TB control measures within the HIV program [14-15]. This study, therefore, sought to determine the prevalence of active tuberculosis among HIV-positive individuals attending Mbarara City Council Health Center IV, and to identify associated clinical and demographic risk factors. By generating facility-specific evidence, the findings of this study aim to support integrated TB/HIV service delivery and contribute to reducing the morbidity and mortality associated with co-infection in Uganda.

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# METHODOLOGY

##  Research design

The study adopted a cross -section descriptive design investigating the prevalence of tuberculosis among Human Immunodeficiency virus positive patients attending ART clinic at Mbarara City Council Health Center IV.

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## Study area

Mbarara City Council Health Center IV, is strategically located in the heart of Mbarara city. It has a large area coverage with villages which are densely populated with mainly business men. Its’ located along Boma A road and is 1.9KM from Mbarara municipal council offices With the Help of campus direction, to the North there is Mwengu Guest house, South there's Mbarara university of science and technology, West South there is kakyeka stadium while on the South East there's Mbarara district regional referral hospital, on the East there is KCB-Bank.

## Study population

The study included all HIV confirmed cases with signs and symptoms suggestive of TB disease and a consented to participate in the study.

## sample size and sampling techniques

The sample size was determined using the formula by Fisher formula.

n=z^2pq/d^2

Where n- is the sample size

Z- standard deviation usually equaling to 1.96 d-is the measure of anticipated error (0.05)

p - is an estimate of the proportion of the people falling in to the group with the desired characteristics, in this study it's 7.7% which is the percentage prevalence of TB infection in HIV patients in Uganda (MOH press release on Uganda AIDS indicator survey *et al* 2011) q=1-p

On substitution

1.96^2×0.077×0.927/0.05^2=

Hence the sample size was 110 HIV patients

## 3.4 Sampling technique

Purposive sampling technique was used in this study in which units were selected basing on the desired characteristics.

### Data collection method

This study employed a facility-based cross-sectional design conducted at the ART clinic of Mbarara City Council Health Center IV. Data were collected using a structured, interviewer-administered questionnaire developed specifically for the study. The questionnaire captured demographic information, clinical history, ART adherence, nutritional status, and tuberculosis screening history. Additional clinical data, including HIV diagnosis dates, CD4 cell counts, and ART regimen details, were extracted from participants’ medical records with their consent. Tuberculosis testing results, including GeneXpert MTB/RIF assay outcomes, chest radiograph reports, and clinician-confirmed TB diagnosis, were also reviewed. To ensure accuracy and consistency, data collection was conducted by trained research assistants under the supervision of the principal investigator. The tools were pretested on 10% of the sample size at a neighboring facility and adjusted accordingly before actual data collection began.

### Data collection tools

The complete well filled questionnaire, pens, pencils HIV register, microscope, slides, Biosafety cabinet, masks and gloves were used to collect data.

### ****HIV Testing and TB Testing****

#### **HIV Testing**

HIV testing was conducted in accordance with the **Uganda Ministry of Health HIV Testing Algorithm**. All participants had previously been diagnosed with HIV and were receiving care at the ART clinic. HIV status was confirmed using a **serial rapid testing algorithm**, which involved **Determine™ HIV-1/2** as the initial screening test, followed by **STAT-PAK®** for confirmatory testing. In cases of discordant results, a third tie-breaker test (**SD Bioline**) was used.

#### **Tuberculosis Testing**

Tuberculosis testing was performed for participants presenting with symptoms suggestive of TB (such as persistent cough, night sweats, weight loss, and fever). The primary diagnostic tool was the **GeneXpert MTB/RIF assay**, performed on sputum samples according to the **National TB and Leprosy Program (NTLP) guidelines**. In cases where sputum could not be produced or TB was suspected but GeneXpert was negative, further evaluation was done using **chest X-rays** and **clinical assessment** by trained healthcare providers. A diagnosis of TB was made based on a positive GeneXpert result, suggestive radiological findings, or clinical judgment in line with WHO-recommended protocols.

### ****Test Result Interpretation****

#### **HIV Test Result Interpretation**

HIV test results were interpreted according to the **Uganda National HIV Testing Algorithm**. A participant was considered **HIV-positive** if both the **Determine™ HIV-1/2** and **STAT-PAK®** rapid tests were reactive. In the event of discordant results, the **SD Bioline** test was used as a tie-breaker; a reactive SD Bioline result confirmed HIV infection. Only individuals with a confirmed HIV-positive status and actively receiving ART at the health center were included in the study.

#### **Tuberculosis Test Result Interpretation**

For tuberculosis, a **positive GeneXpert MTB/RIF** assay was considered confirmatory for **pulmonary TB**. Participants with negative GeneXpert results but with strong clinical suspicion (based on symptoms and physical examination) were further evaluated using **chest radiographs**. Radiological features suggestive of TB—such as upper lobe infiltrates, cavitations, or miliary patterns—combined with clinical judgment by the attending clinician, were used to make a **probable TB diagnosis**. These cases were categorized as **clinically diagnosed TB**. Both bacteriologically confirmed and clinically diagnosed TB cases were included in the TB-positive group for analysis.

## Selection criteria

### Inclusion criteria

The clients who were included in the study had to meet all the following; must be HIV positive, should have signs and symptoms suggestive of tuberculosis, must consent.

### Exclusion criteria

1. Patients who did not consent to participate in the study.
2. Other patients who are not having complaints of cough lasting for two weeks, night sweats, coughing blood, loss of weight, were not included in the study.
3. Also, TB positive patients but HIV negative.

## 3.8 Data processing, analysis and presentation methods

### 3.8.1 Data analysis

Data were entered, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize participants’ demographic and clinical characteristics. Categorical variables (such as gender, ART adherence, TB status) were presented as frequencies and percentages, while continuous variables (such as age and CD4 count) were summarized using means and standard deviations. To assess associations between tuberculosis status and categorical independent variables (e.g., gender, nutritional status, CD4 count category), the Chi-square (χ²) test was applied. Variables with a *p*-value ≤ 0.2 in bivariate analysis were further analyzed using binary logistic regression to determine independent predictors of TB infection among HIV-positive individuals. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. Statistical significance was set at *p* < 0.05.

## Data quality control

* Properly ZN-stained mycobacterium tuberculosis, positive slides were used in hand with

HIV viral load register of the patients to ensure that the results produced are reliable and SMART.

* Stains were filtered
* The slides were not left to dry will heating.
* Over 100 fields were examined before reporting the results.
* The reference TB chart was also used during microscopic examination of TB smears.
* The smears made were not be too thick or too thin.
* The positive smear, having *M*. bacterium tuberculosis will be used as a positive control. Another sputum smear which stains negative for *M*. bacterium shall be used as a negative control.
* Gene expert was used to confirm the true positive specimens.
* The more competent and experienced laboratory personnel were employed to finally confirm true negative and positive smears.

# RESULTS

## Demographic characteristics of the respondents

A total of 110 HIV positive patients were enrolled in the study. The majority of the participants were aged between 31 years – 50 years with 40 (36.4%) respondents and least proportion was aged 15 years and below years with a total respondent of 9 (8.2%) respondents. Majority, 57(51.8%) were females while the least 53 (48.2%) were males. On the other hand, majority 83(75.5%) were businessmen while the least 3 (2.7%) were teachers. The above results are summarized in table 1,2 and 3.

**Table 1: the demographic characteristics basing on age group**

|  |  |  |
| --- | --- | --- |
| Variable  | Frequency (n=110) | Percentage (%) |
| Age categories |  |  |
| 15 years and below  | 9 | 8.2 |
| 16 years – 30 years  | 37 | 33.6 |
| 31 years – 50 years  | 40 | 36.4 |
| 51 years and above | 24 | 21.8 |

**Table 2: the demographic characteristics basing on gender**

|  |  |  |
| --- | --- | --- |
| **Gender**  | **Number** | **Percentage (%)** |
| Male | 53 | 48.2 |
| Female | 57 | 51.8 |

**Table 3: the demographic characteristics basing on profession**

|  |  |  |
| --- | --- | --- |
| **Profession**  | **Number** | **Percentage (%)** |
| Teacher | 3 | 2.7 |
| Business man | 83 | 75.5 |
| Student | 14 | 12.7 |
| Peasant | 10 | 9.1 |



**Figure 1: Pie chart Showing age categories of the respondents**

## The prevalence of TB among HIV persons attending Mbarara City Council Health Center IV.

Out of 110 participants, 19 (17.3%) HIV patients had tuberculosis with confidence interval of (0.313 - 0.432) while 91(82.7%) were tuberculosis negative.

**Table 4: prevalence of TB in HIV positive patients attending Mbarara City Council Health Center IV**

|  |  |  |
| --- | --- | --- |
| **MTB**  | **Frequency (n=110)** | **Percentage (%)** |
| Positive | 19 | 17.3 |
| Negative | 91 | 82.7 |

**The distribution of TB among HIV positive patients by age groups at Mbarara City Council Health Center IV.**

Age categories that range between 15 years and below, 16 years - 30 years, 31 years - 50 years and 51 years and above were considered in this study and showed a statistically significantly distribution of TB among HIV positive patients at Mbarara City Council Health Center IV in the model at 5% level. HIV patients in age group of 51 years and above were 5times more likely to have tuberculosis compared to other age groups followed by those who belonged to age group of 15 years and below (OR =5.73: 95%CI, (.057-2.339: P<0.001). This means that the older and the younger age HIV patients were more susceptible to acquiring Tuberculosis as compared to the middle-aged HIV patients.

**Table 5: The distribution of TB among HIV positive patients by age groups at Mbarara City Council Health Center IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **PREVALENCE OF TB**  | **OR (95% CI)** | **P-Values** |
|  | Positive  | Negative  |  |  |
| Age categories | n=19 | n=91 |  |  |
| 15 years and below | 2(22.2%) | 7(77.8%) | 2.50(.268-1.126)  | 0.001 |
| 16 years - 30 years | 5(13.5%) | 32(86.5%) | Ref |  |
| 31 years - 50 years | 6(15.0%) | 34(85.0%) | 1.98(-.268-.135)  | 0.071  |
| 51 years and above | 6(25.0%) | 18(75.0%) | 5.73 (.057-2.339) | 0.001 |

## The distribution of TB among HIV positive patients by sex at Mbarara City Council Health Center IV

From the study findings, gender was considered in this study in correlation with distribution of TB and showed a statistically significantly distribution in the model at 5% level. HIV patients who were males were 4.9times more likely to have tuberculosis compared to female HIV patients (OR =4.91: 95%CI, (.733-3.910: P=0.001). It is therefore shown that male HIV patients were more likely to get TB as compared to the female HIV patients. The results are shown in table 6 below;

**Table 6: The distribution of TB among HIV positive patients by gender at Mbarara City Council Health Center IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **PREVALENCE OF TB**  | **OR (95% CI)** | **P-Values** |
|  | Positive  | Negative  |  |  |
|  Gender  | n=19 | n=91 |  |  |
| Male  | 13 (24.5%) | 40 (75.5%) | 4.91(.733-3.910)  | 0.001 |
| Female | 6(10.5%) | 51(89.5%) | Ref |  |

# DISCUSSION

This study investigated the prevalence of tuberculosis (TB) among persons living with HIV at Mbarara City Council Health Center IV and found that 17.3% of HIV-positive individuals had active TB, with a confidence interval ranging from 0.313 to 0.432. This prevalence is relatively high when compared to earlier reported national and regional figures, suggesting a significant burden of TB/HIV co-infection in this urban setting. In comparison to prior studies conducted in Uganda, which reported lower co-infection rates ranging between 5.9% and 10%, the observed prevalence in Mbarara may reflect unique sociodemographic, environmental, or behavioral dynamics in the population served by the health facility [16]. One of the contributing factors to the elevated prevalence appears to be occupational exposure, particularly among business people. Individuals engaged in business often interact with numerous clients in enclosed public spaces, increasing their exposure to airborne pathogens such as Mycobacterium tuberculosis. Inadequate infection control practices in such environments, including limited use of masks and poor ventilation, may further heighten this risk. Additionally, behaviors such as coughing in public and frequent handshaking without appropriate hygiene measures facilitate the transmission of TB, especially in densely populated urban areas [17].

Age also emerged as a significant risk factor in this study. HIV-positive individuals aged 51 years and above were approximately five times more likely to be diagnosed with TB compared to those in other age groups. Similarly, HIV-positive children aged 15 years and below exhibited an increased risk of TB infection. These findings suggest a U-shaped age-related vulnerability, with both the elderly and the very young being disproportionately affected. Older individuals are likely more susceptible due to age-related immune senescence, characterized by a decline in the regenerative capacity of the immune system. In contrast, children may be at risk due to underdeveloped immune defenses and limited ability to recognize or report TB symptoms, delaying diagnosis and increasing transmission potential within households and communities [18-19]. Gender differences in TB prevalence were also observed, with male HIV-positive patients being 4.9 times more likely to have TB compared to their female counterparts. This aligns with broader global patterns showing higher TB incidence among males. Social behaviors and occupational patterns may contribute to this discrepancy. Males are often more involved in activities that increase their social contact, such as business meetings, public gatherings, and frequent travel, thereby increasing their risk of TB exposure. Furthermore, disparities in healthcare-seeking behavior may result in delayed diagnosis among men, contributing to higher TB prevalence [20].

## CONCLUSION

The findings of this study reveal a notably high prevalence of tuberculosis among HIV-positive individuals attending Mbarara City Council Health Center IV, with 17.3% of respondents co-infected. The study identified significant associations between TB co-infection and key demographic factors, including age, gender, and occupation. Specifically, older adults (aged 51 years and above), children (aged 15 years and below), male patients, and those engaged in business-related occupations demonstrated a higher likelihood of TB infection. These trends underscore the complex interplay between immunosuppression, social exposure, and behavioral risk in the development of TB among people living with HIV.

The results emphasize the urgent need for integrated, targeted, and sustained interventions aimed at strengthening TB screening and prevention within HIV care settings. Enhanced public health awareness, routine TB screening for high-risk groups, improved infection control in public and occupational environments, and strengthened diagnostic capacity are crucial to reduce the burden of TB/HIV co-infection. Addressing these challenges through patient-centered care, community outreach, and health system strengthening will be vital in mitigating the dual impact of TB and HIV in urban centers such as Mbarara.

**Ethical Approval:**

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

# LIST OF ABBREVIATIONS

AIDs......................... Acquired Immunodeficiency syndrome

AHD.......................... Advanced HIV Disease

ART............................Anti-retroviral therapy

CD4........................... Clusters of differentiation 4

HIV............................. Human Immunodeficiency Virus

PW HIV...................... People Living with Human Immunodeficiency Virus

TB.............................. Tuberculosis

UNICEF...................... United Nations Children Emergency Fund

WHO...........................World Health Organization

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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