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Prevalence of mycobacterium tuberculosis among HIV/AIDS positive elderly patients attending art clinic at bombo health centre IV in Luweero district: descriptive A cross-sectional study.

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Abstract

Background

Mycobacterium tuberculosis, the bacterium that causes tuberculosis (TB), infects approximately a third of the global population (WHO, 2015).
Globally, tuberculosis is unequally distributed in the world, with the highest incidence rates found in developing countries. The study assessed the prevalence of Mycobacterium tuberculosis among HIV/AIDS positive elderly patients who will attend the ART clinic at Bombo Health Centre IV in Luweero District.

Methodology

The study used a descriptive cross–sectional study design that employed both quantitative and qualitative methods of data collection, because it helped the researcher to collect data in a short period of time and was also cost-effective.

Results

The overall prevalence of MTB among elderly positive patients who attended Bombo Health Centre was 33.6%, with 40 participants positive for MTB and 79(66.4%) participants negative for MTB.

Conclusion

The research study showed that the prevalence of Mycobacterium tuberculosis among HIV positive elderly patients who attended Bombo Health Centre was 33.6%.
It was found that the highest prevalence of Mycobacterium tuberculosis was in the age group of 50-59, by 45%.
The research findings showed that the prevalence of Mycobacterium tuberculosis was high among males, with 75% of Positive MTB cases, compared to 25% among females.
There was a higher possibility of MTB positivity among elderly adults who lived in crowded places and were active smokers compared to their counterparts who didn't live in crowded places and were not smokers, respectively.

Recommendation

People should be sensitized by the Government to know the disease in detail, that is, its spread and prevention.
Patients with Mycobacterium tuberculosis should receive counselling and assistance in stopping smoking.

Keywords: *Prevalence, Mycobacterium Tuberculosis, HIV/AIDS Elderly Patients, ART Clinic, Bombo Health Centre IV*
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Background

Mycobacterium tuberculosis, the bacterium that causes tuberculosis (TB), infects approximately a third of the global population (WHO, 2014).
Globally, tuberculosis is unequally distributed in the world, with the highest incidence rates found in developing countries. The highest estimated incidence was in South-East Asia and Western Pacific regions (56%) and in the Africa Region (28%). The 22 high-burden countries account for approximately 80% of the estimated number of new tuberculosis cases (all forms) arising worldwide each year, and nine of them are in Africa. The same report noted that in 2014, only 6 million of the 9.6 million incident cases (63%) were detected and notified to National Tuberculosis Programmes (NTPs) or national surveillance systems globally.
Sub-Saharan Africa statistics by Zumla et al. (2015) confirmed that the consistently high rates of TB in this region can be attributed in part to population growth and accelerating urbanization, poverty, inadequate health infrastructure, insufficient case-detection rates, and the high prevalence of HIV/AIDS. Given these challenges (and despite slow global reductions in both TB incidence and prevalence), it does not appear that the 2015 Millennium Development Goal (MDG) target of a 50% reduction in the TB prevalence from 1990 to 2015 has been met worldwide.
East African TB showed that in 2012, the World Health Organization (WHO) ranked Tanzania
16th highest tuberculosis burden globally, with a prevalence of 176/100000 (WHO, 2013). In 2002, the WHO estimated that in Tanzania, tuberculosis ranked 7th as a cause of death among people older than 5 years, and that in 2012, HIV, tuberculosis, and malaria accounted for more Disability-Adjusted Life Years (DALYs) and deaths than any other diseases (Country Health System Fact Sheet 2016)

National Tuberculosis and Leprosy (2013) reported that the HIV/AIDS epidemic has caused the number of tuberculosis cases to increase rapidly since the early 1980s. The sharp annual increase in tuberculosis cases, between 5% and 10% experienced in the 1990s, reached a peak in 2001 and remained relatively steady thereafter, with an average annual increase of only 2% between 2000 and 2010.

In Uganda, Tuberculosis remains a major public health problem with an annual incidence of 330 cases of all forms and 136 new smear-positive cases per 100,000 people per year. The expected case load per year is 102,000. (WHO, 2018)

The 2012 Global WHO Report ranked Uganda 16th among the 22 TB high-burden countries. Uganda, like most of Sub-Saharan Africa, is battling with the dual Tuberculosis and HIV/AIDS epidemic. It is estimated that about 60% of the TB patients are co-infected with HIV/AIDS. This dual epidemic has resulted in a fourfold increase in the notification numbers of TB cases in the region. (WHO, 2012)

Furthermore, TB stands as the number one killer of HIV/AIDS patients. The clinical presentation of TB among the dually infected persons changed, and this has a bearing on the clinical management and design of public health interventions to respond to the dual epidemic (Kanmani et al., 2024).

Though a lot of Mycobacterium tuberculosis cases are reported in Bombo Health Centre IV in Luweero District, there has not been a clear, pinpointed study that has established the general magnitude of the prevalence of Mycobacterium tuberculosis among elderly HIV patients attending the ART clinic. The study assessed the prevalence of Mycobacterium tuberculosis among HIV/AIDS positive elderly patients who will attend the ART clinic at Bombo Health Centre IV in Luweero District.

Methodology

Study Design and Rationale

The study used a descriptive cross–sectional study design that employed both quantitative and qualitative methods of data collection, because it helped the researcher to collect data in a short period of time and was also cost-effective.

Study setting and rationale

The research study was conducted at Bombo Health Centre IV in Luweero District. Main services provided at Bombo Health Centre IV include: Outpatient department, Laboratory department, Maternity Child Health (MCH), Family planning (FP), and young child clinic. It also provides antenatal, postnatal, eye care services, ear, nose, and throat, voluntary counseling, and testing (VCT), Elimination of Mother to Child Transmission of HIV (EMCTCT), safe male circumcision (SMC), among others. Bombo Health Centre IV has 11wards which include: surgical, 2 medical (male and female), maternity and postnatal, gynecology, eye, urological, psychiatric, and children's ward, Tuberculosis ward having over 380 patients and 6 of them having MDR, and over fifteen nurses in these medical wards (Bombo Health Centre IV Records, 2016).

The study setting was chosen because there is an increment in the prevalence and risk factors of Mycobacterium tuberculosis among HIV/AIDs positive elderly patients who attended the ART clinic at Bombo Health Centre IV in Luweero District. Therefore, that health facility was an ideal study area for the researcher to obtain the data for study purposes.

Study population

The study population included HIV/AIDs positive elderly patients (both males and females) who attended the ART clinic at Bombo Health Centre IV in Luweero District during the time of study.

Sample size determination

The study sample size was determined according to the following for cross-sectional studies (Sekaran *et al.*, 2012).

$$N=\frac{Z^2 P(1-p)}{D^2}$$

Where N=desired sample size

Z=Number of standard deviations, usually set at 1.96, which corresponds to 95% level of confidence.

P=Target population estimated to have a particular characteristic. In the absence of a known estimate, the researcher used P=0.5 since it gives the most conservative sample size.

D = degree of accuracy level, which is 0.09(9%)

(1-p) is the proportion of the population without a characteristic.

Using the above formula: $N=\frac{1.962 \times 0.5(1-0.5)}{0.092}$

$=119.0$

Therefore, the sample size is 119 HIV/AIDs positive elderly patients.

Sampling Technique

A simple random sampling technique was used because it gives a chance to every selected participant to take part in this study.

Sampling Procedure

A simple random sampling procedure was used to select 119 HIV/AIDs positive elderly patients who were sent to the laboratory for Mycobacterium tuberculosis investigation.

A total of 238 small papers were folded, written with yes and no for each participant to pick, and whoever picked a no was omitted from the study, while those who picked a yes were included in the study. This entire exercise of recruitment lasted for a duration of 5 days until the desired sample size of 119 Mycobacterium tuberculosis HIV/AIDs positive elderly patients was reached.

Data Collection Tools

The researcher used a pre-tested questionnaire that comprised of open and closed-ended questions that addressed the specific objectives of the study.

Data Collection Procedures

The researcher collected data by self-administering the questionnaire to Mycobacterium tuberculosis suspected HIV/AIDs positive elderly patients. The researcher then gave a reasonable amount of time to fill in their views and responses, after which she collected the questionnaires from them. Checking through the questions was done on the spot. The researcher collected data from at least 30 respondents per day.

Specimen collection and laboratory analysis

Specimen collection and procedure for Laboratory analysis were carried out following the Standard Operating Procedure for using the GeneXpert machine.

Principle of operation for a GeneXpert

GeneXpert detects MTB DNA and rifampicin resistance by amplifying a specific DNA sequence of the rpoB (associated with rifampicin resistance) using real-time PCR within a closed cartridge system.
The system provides automated sample processing, amplification, and detection in under 2 hours.

Specimen collection

The specimen was collected by the patient following the guidelines from the researcher. This involved coughing and releasing sputum into a wide-mouth container and immediately bringing the sample to the hospital.
MTB screening was done using the PCR method (Gene Expert). The test was performed immediately after the specimen was collected. For short-term storage, the specimens were kept in a biosafety cabinet at room temperature. For long-term storage, specimens were kept below 8°C.
The specimens were brought to room temperature before testing.

Laboratory procedures

- Allow sputum liquefaction and inactivation with 2:1 sample reagent.
- Transfer of 2ml material into the test cartridge.
- Insert the cartridge into the MTB-RIF test platform.
- The sample is then automatically filtered and washed.
- It undergoes ultrasonic lysis of filter-captured organisms to release DNA.
- DNA molecules are then mixed with dry PCR reagents.
- Semi-nested real-time amplification and detection in an integrated reaction tube occur.
- Then the results are printed out after 1hour and 45minutes.

Results interpretation

MTB results	**Interpretation**
MTB Detected	Mycobacterium tuberculosis complex DNA is present in the sample
MTB Not detected	No detectable MTB DNA
Invalid	Test failed due to improper sample processing.
Error	System or technical issue

Piloting the Study

Pretesting of questionnaires was carried out at Geralyn Medical Centre to test for the validity and reliability of the questionnaire.

Quality Control

The researcher made sure that the patients produced the right quantity and quality of sputum specimen without saliva.
Proper techniques were employed during specimen procession and examination.

The microscope was serviced and properly cleaned before microscopic examinations were done and checked using any positive slides available.
The quality of the reagents used in the staining process was ensured through proper techniques of preparation, and they were filtered before use. The quality of the reagents was checked by staining with both positive and negative samples.
The examination technique was up to date by an experienced person, such as a laboratory technician or laboratory assistant.

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Two research assistants were trained to help the researcher during data collection in order to ensure the validity of results.

Data analysis and Presentation

Coded data was entered in a computer using Statistical Packages for the Social sciences (SPSS) version 16. Statistical analysis was carried out to correlate predisposing factors with MTB results, and p-values were generated. P-Values < 0.05 were considered significant. Microsoft Excel was used to present data in the form of tables and figures. Tables and figures were explained using brief narratives.

Independent variable

This included social demographic data such as age, sex, marital status, tribe, and religion, level of education, and area of residence, among others.

Dependent Variables

These included: the prevalence and risk factors of Mycobacterium tuberculosis.

Ethical considerations

After approval of the proposal by the supervisor and the principal of Mildmay Institute of Health Science
An introductory letter from the principal was obtained, introducing the researcher to the person in charge of Bombo Hospital. The purpose of the study was explained to him.
The person in charge, in turn, introduced the researcher to the heads of the respective wards/ departments.
The researcher then explained to them the research purpose, potential risks involved in participating in the study, and assured them of the utmost confidentiality of their responses, and requested them to voluntarily consent in order to participate in the study.
Confidentiality was ensured by the use of serial numbers on questionnaires of respondents.

Results

Socio-demographic characteristics of HIV positive elderly patients who attended ART clinic at Bombo Health Centre IV

Table 1: A table showing bio data of the HIV positive elderly patients who attended the ART clinic

	N = 119	
Category	**Number assessed**	**Percentage Assessed**
Age group (years)		
30 – 39	27	22.7
40 – 49	40	33.6
50 – 59	52	43.7
Total	**119**	**100**
Gender		
Male	70	58.8
Female	49	41.2
Total	**119**	**100**

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Patients	Frequency (n)	Percentage (%)
No. of positive patients for MTB	40	33.6
No. of negative patients for MTB	79	66.4
Total	**119**	**100**
Marital Status		
Married	43	36.1
Not married	76	63.9
Total	**119**	**100**
Residence		
Rural (Village)	53	44.5
Urban (Town)	66	55.5
Total	**119**	**100**

The total number of HIV positive elderly patients who were involved in the study was 119. The modal age group assessed was between 50-59 years, with 52 (43.7%) elderly adults, followed by 40 (33.6%) and 27 (22.7%) among age groups 40-49 years and 30 – 39 years, respectively. Among the elderly adults, 70 were males, and 49 were females. There were more unmarried elderly adults (63.9%) than the married ones (36.1%). Most of the adults who participated in the study resided in Bombo Town / Urban area 66.0 (55.5%). and 53.0(44.5%) come from rural (village)

Prevalence of MTB among HIV/AIDS positive elderly patients who attended ART clinic at Bombo Health Centre IV

Table 2: A table showing the prevalence of MTB among HIV/AIDS positive elderly patients who attended ART clinic at Bombo Health Centre IV

Table 2 above shows that the overall prevalence of MTB among elderly positive patients who attended Bombo Health Centre was 33.6%, with 40 participants positive for MTB and 79(66.4%) participants negative for MTB

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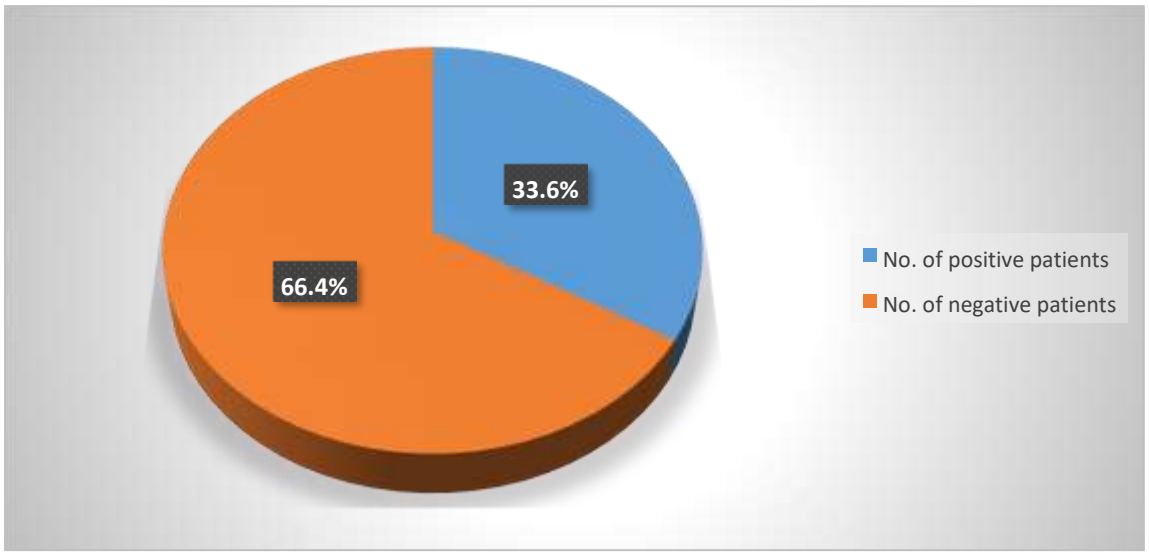
Figure 1: A pie chart showing the prevalence of MTB among elderly HIV positive patients attending Bombo Health Centre IV



Prevalence of MTB by age group among HIV/AIDS positive elderly patients

Table 3: A table showing the prevalence of MTB by age group among elderly HIVAIDS positive patients

Patients' age group (years)	MTB detected		MTB not detected	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
30-39	10	8.4	20	16.8
40-49	12	10.1	19	16.0
50-59	18	15.1	40	33.6
Total	**40**	**33.6**	**79**	**66.4**

The highest prevalence of Mycobacterium tuberculosis in elderly HIV positive patients by age was 18(15.1%) among the age group of 50-59 years, followed by 12 (10.1%) and 10 (8.4%) among the age groups 40-49 years and 30-39 years, respectively.

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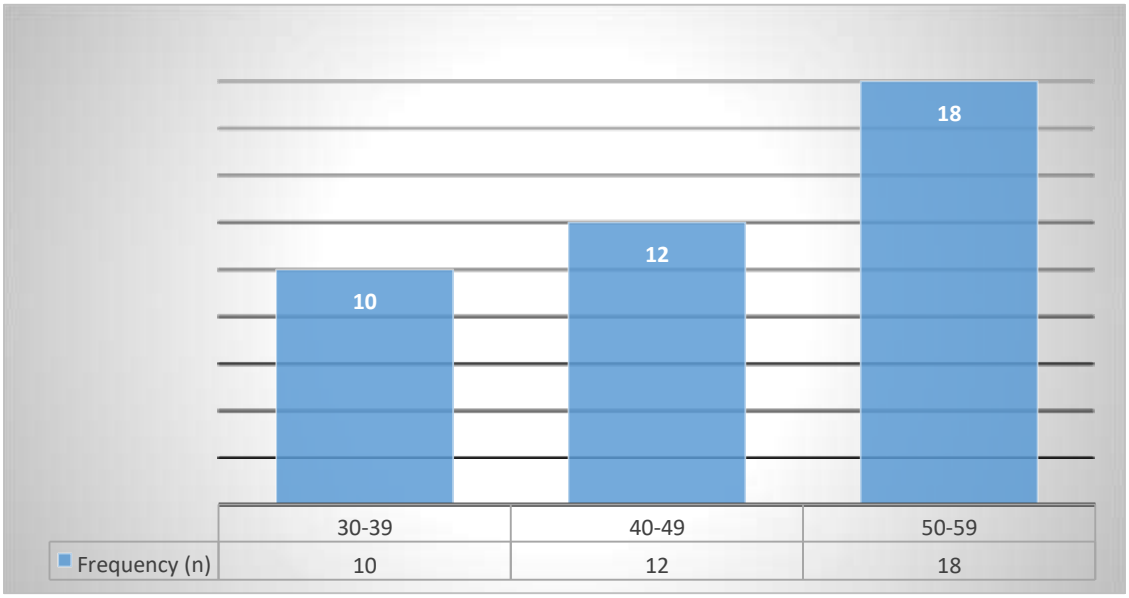
Figure 2: A bar graph showing Frequency of MTB by age among elderly HIV positive. Patient.



Prevalence of mycobacterium tuberculosis according to gender among HIV/AIDS positive elderly patients

Prevalence of Mycobacterium tuberculosis was higher among Male 30 (75%) than female 10 (25%) among elderly positive patients.

Table 4: A table showing the prevalence of MTB according to gender among HIV positive elderly patients

Gender	Positive		Negative	
	Frequency (F)	Percentage (%)	Frequency (F)	Percentage (%)
Male	30	25.2	59	49.6
Female	10	8.4	20	16.8

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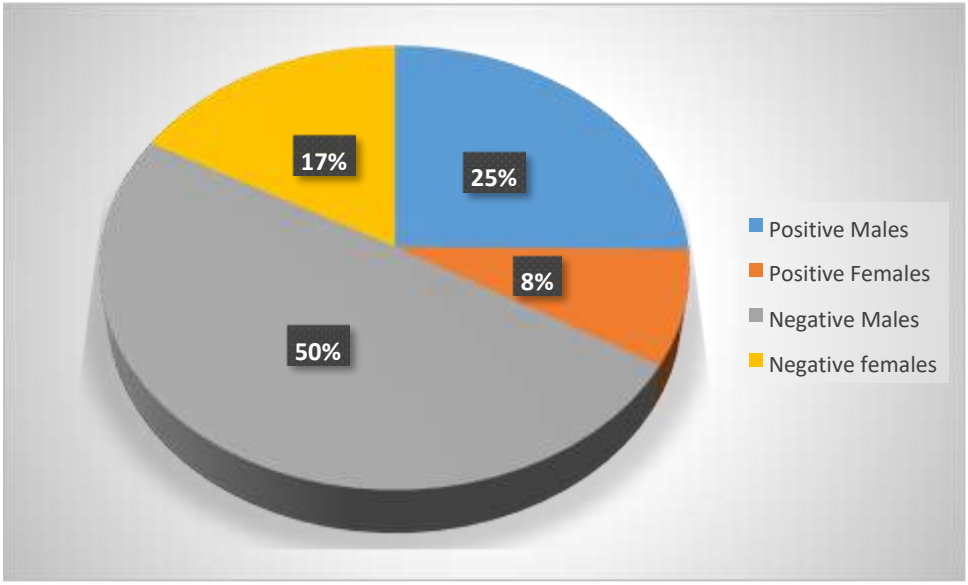
Figure 3: A pie chart showing the prevalence of MTB according to gender among elderly HIV patient



Predisposing factors for Mycobacterium tuberculosis among elderly HIV positive patients

Table 5: A table showing predisposing factors for MTB among HIV positive elderly patients

Factor			MTB detected		MTB not detected	Percentage of patients with TB		
Overcrowding	yes	no	Yes	No	yes	no	yes	no
	45	74	25	15	20	59	21	12.6
Smoking	34	85	22	18	12	67	18.5	15.1
Poor nutrition	22	97	10	30	12	69	8.4	25.2
Taking alcohol	20	99	12	28	8	61	10.1	23.5

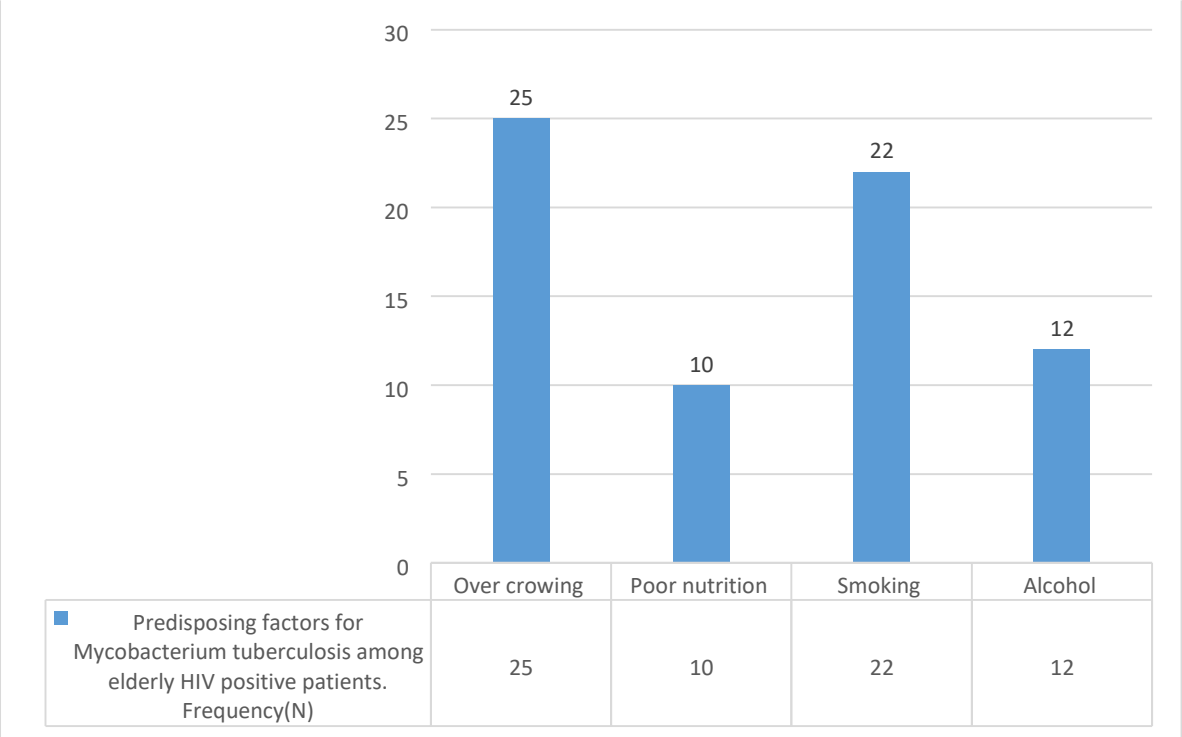
The table above shows that HIV/AIDS elderly patients staying in overcrowded settings are highly predisposed to MTB, with 21%. 45 patients were found to be staying in overcrowded places, and 25 of them tested positive with MTB. This highly agrees with the earlier research, such as (Bhatti *et al*., 1995; Gutierrez *et al*., 1998; Elender *et al*., 1998; Dye *et al*., 2009) that highlighted overcrowding as a serious factor responsible for MTB prevalence among the HIV/AIDs patients.

Among the 119 patients, 34 were found to be active smokers, and 22 of the 34 were found to be positive with MTB. This made those who are infected with both HIV and MTB and are smokers have a percentage of 18.5%, making smoking a second-placed predisposing factor contributing to a high prevalence of MTB among the HIV/AIDs elderly patients attending the ART clinic at Bombo health center IV. This was in agreement with earlier research that found Smoking to be associated with both relapse of Mycobacterium tuberculosis and Mycobacterium tuberculosis mortality (Singh *et al*., 2005; Coker *et al*., 2006). 20 patients were found to be alcoholics, and 10 among them had MTB, with a percentage of 10.1%. This means that HIV/AIDs patients taking alcohol have increased chances of getting MTB. This percentage might have been contributed to by smoking, since most of the smokers also consume

alcohol. Earlier researches like (Borgdorff *et al*. (1998), Auer *et al*. (2000), and Dale *et al*. (2005), also listed these factors among others to be responsible for MTB prevalence among HIV patients.

Poor nutrition was also found to be responsible for the Prevalence of MTB among the HIV/AIDs elderly patients attending the Art clinic at Bombo health center IV, with 8.4% of the population having poor nutrition and infected with both HIV and MTB. This was explained in the earlier research that malnutrition and intestinal parasites cause immune suppression, which in turn may cause false-negative tuberculin skin tests (TST) and failure to identify Mycobacterium tuberculosis infection (Zacharia *et a*l., 2006; Lawson *et al*., 2008).

Figure 4: A bar graph showing the predisposing factors for MTB among elderly HIV patients



Discussion

The general prevalence of Mycobacterium Tuberculosis among HIV/AIDS positive elderly patients attending the ART clinic at Bombo Health Centre IV in Luweero district

Out of a 119 population sample selected among the HIV/AIDs elderly patients attending the art clinic at Bombo Health Center IV, 40 patients were positive with Mycobacterium tuberculosis, contributing to 33.6%, and the remaining 79 patients (66.4%) were negative. This agrees with the report from the World Health Organization that stated and ranked Uganda among the 30 high TB/HIV burden countries according to the WHO (2023). It also agrees with Kirenga's research that concluded that HIV prevalence among TB patients in Uganda is estimated between 36% and 40, while TB is detected in about 20% to 30% of HIV patients, especially those attending ART clinics (Kirenga *et al.,* 2020; Uganda Ministry of Health, 2022). It was further found out that the prevalence of Mycobacterium tuberculosis among the HIV/AIDs positive elderly patients attending the art clinic at Bombo health center IV was closely related to the age of the patient, gender, and predisposing factors like overcrowding, smoking, and alcoholism, which highly influence it. The same factors were discovered in the earlier studies, like (Katherine, Elizabeth, Peter, 2014), (Corbett *et al*., 1999; Godfrey-Faussett and Ayles, 2003; Cailhol *et al*., 2005; Reid *et al*., 2006), among others.

The prevalence of Mycobacterium tuberculosis according to age group

This study aimed at determining the prevalence of Mycobacterium tuberculosis among HIV positive elderly patients at Bombo Health Centre IV in Luweero district. An increase in the prevalence of Mycobacterium tuberculosis with an increase in the age of the elderly patients was observed. The lowest prevalence of MTB (25%) was among elders aged 30 – 39 years, and the highest prevalence.

(45%) among elders aged 50-59 years. This finding closely correlates with the one observed by Snow *et al* (2018) in the Philippines, which reported the lowest (3.7%) and highest (17.0%) prevalence of MTB among adults aged 30 – 40 years and adults aged 50-60 years, respectively. This is also in line with Kathryn et al (2017), who reported the lowest prevalence of MTB (4.3%) among 30-35 year olds and the highest prevalence (58.2%) in 50-55 year olds. Global estimates of the burden of Tuberculosis among elderly adults observed that the lowest prevalence was among elders aged 30-39 years, and the highest prevalence of MTB was among elders aged 50-59 years (Kathryn *et al,* 2019).

The prevalence of Mycobacterium tuberculosis according to gender

In this research, the prevalence of Mycobacterium tuberculosis was slightly higher among males (75%) compared to females (25%) among female adults. This result correlates with the study that was carried out to determine sex differences in tuberculosis burden and notifications in low-and middle-Income countries, which showed that tuberculosis case notification rates are usually higher in men than in women (Katherine *et al,* 2014). Fernandez and Hochberg (2018) also discovered that there are increased odds of MTB infection for males aged 15-39 years than women in Brazil. High prevalence of MTB among male adults could be due to the relatively poorer social habits among male youths, like sharing cigarettes and beer bottles with their peers who may be having the disease. However, differing from this study, findings of tuberculosis infection based on gender by UNDP (2015) discovered that in some countries, more women than men are detected with MTB. In countries with high HIV prevalence, more women are notified of MTB than men. This may probably be due to social and demographic differences in those countries that expose more women than men to MTB infection.

The predisposing factors to Mycobacterium tuberculosis among HIV/AIDS positive elderly patients

Predisposing factors such as overcrowding and smoking showed higher probabilities of MTB positivity than living in non-crowded places and not smoking, respectively. This could be due to reduced air circulation in overcrowded places, where, in the event of an infected person being present, the transmission rates will increase since the disease is airborne. Most chain smokers have a habit of sharing cigarettes, which also facilitates the spread of the disease among smokers. This observation is in line with research findings that were carried out in some industrialized countries, which showed that risk factors such as overcrowding led to increased prevalence of Mycobacterium tuberculosis in those countries. (Bhatti *et al.,* 1995; Gutierrez *et al.,* 1998; Elender *et al.,* 1998). The study that was carried out by Bergdorf and Auer also indicated a clear association of tobacco smoking with tuberculosis infection (Borgdorff *et al.,* 1998; Auer et al., 2000; Dale *et al.,* 2005). It also agrees with the study findings of Lienhardt, Davis, and Patel, which indicated that 40 to 60% of the smokers are likely to develop active Mycobacterium tuberculosis (Lienhardt *et al.,* 2005; Davies et al., 2006; Patel *et al.,* 2007).

Conclusion

The research study showed that 40 patients among 119 HIV positive elderly patients who attended Bombo Health Centre were positive with Mycobacterium tuberculosis, contributing to 33.6%. It was found out that the highest prevalence of Mycobacterium tuberculosis was in the age group of 50-59, where 15 patients out of 40 (45%) with Mycobacterium tuberculosis were from this group. The research findings showed that the prevalence of Mycobacterium tuberculosis was high among males, with 30 patients (75%) of Positive MTB cases, compared to 10 patients (25%) among females. There was a higher possibility of MTB positivity among elderly adults who lived in crowded places, 25 (21%), and were active smokers, 22 (18.5%), compared to their counter parts who didn't live in crowded places 15 (12.6%) and were not smokers 18 (15.1%) respectively.

Recommendation

People should be sensitized by the Government to know the MTB in detail, that is, its spread and prevention.
Patients with Mycobacterium tuberculosis should receive counselling and assistance in stopping smoking.
More Research is needed on MTB so as to establish the routes of the infection into communities. The government should at least check homes for hygiene and proper housing to avoid overcrowding, which may result in the easy spread of tuberculosis.
More sensitization should be done to educate people about the screening of this disease. This can be done through media platforms.

Acknowledgement

I would like to thank the almighty God for allowing me to be where I am, what I've become, and what He has done and so far accomplished in my life. I would also like to acknowledge my supervisor, whose scholarly advice, help, constant encouragement, and support have contributed generously to my study. My gratitude goes to the Mildmay Institute of Health Science library staff for making reference books available for my study. To you all, may the good Lord Almighty reward you accordingly.

Abbreviations

AFB: Acid Fast Bacilli
AIDS: Acquired Immunodeficiency Syndrome
BMI: Body Mass Index
CTRL: Central Tuberculosis Reference Laboratory
CXR: Chest X-ray
DMO: District Medical Officer
DOTS: Direct Observed Treatment Short Course
DTLC: District Tuberculosis and Leprosy Coordinator
HIV: Human Immunodeficiency Virus

NTLP: National Tuberculosis and Leprosy Control Programme
NTP: National Tuberculosis Programme
SOP: Standard Operating Procedure
TB : Tuberculosis
WHO: World Health Organization
ZN: Ziehl Nielsen

Source Funding

This research study was not funded

Conflict of Interest

The author declares that there was no conflict of interest regarding the publication of this research study.

Author Contributions

Nakiweewa Brinah conceptualized the study, developed the proposal, collected data, performed laboratory analysis, analyzed and interpreted the data, and prepared the final research report under the supervision of Mr. Anthony Isaiah Ssekitoleko and the guidance of the Institutional Research Committee.

Data Availability

The datasets used and/or analyzed during this study are available from the corresponding author upon reasonable request. The data are stored securely to maintain participant confidentiality.

Ethical Approval

Ethical approval to conduct this study was obtained from the Institutional Research Committee (IRC) of Mildmay Institute of Health Sciences. Administrative permission was also obtained from the person in charge of Bombo Health Centre IV before the commencement of data collection.

Informed Consent

Written informed consent was obtained from all participants before their inclusion in the study. Participants were informed about the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw at any time without any consequences. Confidentiality was strictly maintained throughout the study.

Author Biography

Nakiweewa Brinah is a Diploma graduate in Medical Laboratory Technology from Mildmay Institute of Health Sciences under the Uganda Allied Health Examinations Board. She has practical experience in clinical laboratory diagnostics, particularly in tuberculosis and HIV-related investigations. Her academic interests include infectious diseases, public health research, and improving diagnostic approaches for vulnerable populations.

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