



Prevalence of *Mycobacterium tuberculosis* among HIV Patients Attending Federal Medical Centre Asaba, Delta State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The study aimed to ascertain the prevalence of tuberculosis among HIV-positive patients at the Federal Medical Center Asaba in Delta State, Nigeria.

Study Design: This study engaged a cross-sectional study design to prevalence of *Mycobacterium Tuberculosis* among HIV Patients Attending Federal Medical Centre Asaba, Delta State.

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Place and Duration of the Study: The study was conducted in Federal Medical Center. Data collection spanned a specific duration from November, 2022 to January, 2023.

Methodology: A total of 188 samples were obtained from known HIV patients. The patients were selected by random sampling technique. The samples were analysed using GeneXpert machine (GX2.1 model) with the nuclei acid amplification (NAA) of DNA mycobacterium tuberculosis complex (MTBC) and resistance to rifampicin. Demographic data of participants were obtained through questionnaires.

Results: Out of 188 samples from HIV patients analyzed, MTB was detected in 13 (8.7%) patients with the highest prevalence recorded among male subjects 6(12%). Age group 19-29 was the most prevalent of MTB among the test subjects.

Conclusion: *Mycobacterium tuberculosis* is widespread among HIV patients in Asaba, Delta state, according to these data. As a result, patients must be encouraged to adhere to treatment and preventive measures.

Keywords: Human immunodeficiency virus; *Mycobacterium tuberculosis*; GeneXpert; asaba.

1. INTRODUCTION

“Co-infection with tuberculosis (TB) and human immunodeficiency virus [HIV] is a major public health issue worldwide” [1]. Persons living with HIV (PLHIV) have a 20-fold higher lifetime risk of having active TB than persons without HIV [2]. Tuberculosis kills more people worldwide than any other infectious disease [3]. “Early and accurate detection of drug sensitive and treatment resistant TB is critical for attaining worldwide tuberculosis control. However, underdiagnosed remains a significant barrier, particularly in countries where patients confront significant geographical and socioeconomic obstacles in getting health care” [4]. Despite greater access to antiretroviral medication (ART), mortality in PLHIV remains high, with tuberculosis being the major cause of death [5]. “TB is the top cause of mortality, surpassing HIV/AIDS, making it a global public health concern. TB causes around 9 million new infections and 1.5 million deaths worldwide each year” [6].

“The development of the HIV/AIDS pandemic is a significant contributor to the global increase in TB incidence” [2]. “Especially in undeveloped countries like Nigeria, where malnutrition is still a major issue. With 586,000 (345,000 -890,000) incidence cases and 100,000 (56,000 -155,000) HIV positive incident TB patients in 2013, Nigeria placed fourth among twenty-two high TB burden countries” [2]. “In Kano, northwest Nigeria, 14.7% frequency was found among infectious illness hospital patients” [7]. “In Southeast Nigeria, the prevalence of HIV/TB co-infection is 17.2%” [8]. “The detection of *Mycobacterium tuberculosis* by culture and biochemical identification is the gold standard for diagnosing tuberculosis. However,

this procedure is time-consuming and requires specialized laboratory equipment and expertise” [9]. The GeneXpert is an automated device that analyses sputum specimens quickly and concurrently, detecting *Mycobacterium tuberculosis* complex and rifampicin resistance mutations in the *rpoB* gene [6].

The rising prevalence of HIV/TB co-infection is concerning. Understanding the incidence of tuberculosis among HIV seropositive people and the risk factors associated with it is critical for the effective planning and execution of interventions to prevent TB and HIV co-infection in Delta state. As a result, the study seeks to ascertain the prevalence of tuberculosis among HIV-positive patients at the Federal Medical Center Asaba in Delta State, Nigeria.

2. METHODOLOGY

2.1 Study Area

This study was conducted at Federal Medical Centre Asaba, Oshimili South local government area of Delta State, Nigeria.

2.2 Sample Size Determination

The sample size was determined based on the prevalence rate of the study done and calculated with the formula recommended by Uzoagulu 1988. The estimate is desired to be with 5% margin of error and 95% confidence.

$$N = \frac{Z^2 \cdot aP}{d^2} [1-P]$$

d2

Where N= patient who should be sampled

Za =the standard normal deviation corresponding, 95% of confidence level =1.96

P= prevalence [2%]

d= the degree of accuracy desired [2%=0.02]

$$N = \frac{[1.9] \times 0.02}{[0.02]} = 188$$

2.3 Study Population

The study Population was HIV patients with cough attending Federal medical Centre Asaba, Delta State. A total number of 188 samples were collected from HIV patients after due consultation with the patients.

2.4 Questionnaire

Questionnaire was used to obtain the demographic characteristics; possible risk factors and other relevant information to the study as well as an informed consent were administered to the participants.

2.5 Sample Collection

Sterile universal bottles were given to the patient and adequately instructed on the type of sample to be collected and that aseptic condition was required. The sputum samples were brought to the laboratory within 5 minutes.

2.6 Sample Processing

- Macroscopy Examination The sputum sample was examined macroscopically with naked eyes and was reported accordingly

2.6.1 Analysis of sputum samples for mycobacterium tuberculosis using genexpert

The sputum samples were processed using geneXpert machine. The procedure described by WHO [2014] was used for this study.

2.6.1.1 Principles of genexpert

“GeneXpert MTB/RIF assay is a nuclei acid amplification (NAA) test which simultaneously detects DNA of *Mycobacterium tuberculosis* complex (M1BC) and resistance to rifampicin (RIF) (i.e mutation of the rpoB gene) in less than 2 hours” [10].

2.6.1.2 Method of genexpert

“This system integrates and automates sample processing, nuclei acid amplification, and detection of the target sequences. The primers in the Xpert MTB/RIF assay amplify a portion of the rpoB gene containing the 81-base pair "core" region. The probes are able to distinguish between the conserved wild type sequence and mutations in the core region that are associated with rifampicin resistance” [10]. “The centers for Disease control and prevention (CDC) recommends that NAA testing be done on at least one respiratory sample from patients that have a moderate or high suspicion of having pulmonary TB” [10].

2.6.1.3 Basic procedure for gene xpert

“The Sample collected from the HIV patient on HAART with suspended TB was mixed with the reagent that is provided with the assay, and a cartridge containing this mixture is then placed in the GeneXpert machine. All processing from this point on is fully automated” [10].

2.6.1.4 Interpretation of genexpert results

The results from the Xperts MTB/RIF indicate whether or not MTBC was detected in the specimen. In some cases, the result is "Invalid" in which the investigation should be repeated [10]. If MTBC was detected, the results will also indicate if resistance to RIF was:

- Detected: Mycobacteria have a high probability of resistance to RIF; this should be confirmed by additional testing. If RIF resistance is confirmed, rapid molecular testing drug resistance to both first - line and second line drugs should be performed so that effective treatment regimen can be selected.
- Not Detected: Mycobacteria are probably susceptible to RIF, all test that are positive for MTBC should have growth-based susceptibility testing to first - line TB drugs.
- Intermediate: the test could not accurately determine if the bacteria are resistant to RIF. Growth – based susceptibility testing to first – line TB drugs should be performed.

3. RESULTS

The following results were obtained from this study, analyzed and presented in tables.

Table 1. Demographic data

| | | Frequency (N) | Percent (%) |
|-------------------|--------------------|---------------|-------------|
| Sex | Female | 105 | 55.9 |
| | Male | 83 | 44.1 |
| Age range | Less than 20 years | 15 | 8 |
| | 20-29 years | 44 | 23.4 |
| | 30-39 years | 40 | 21.3 |
| | 40-49 years | 40 | 21.3 |
| | 50-59 years | 25 | 13.3 |
| | 60 years & above | 24 | 12.8 |
| Specimen | Sputum | 186 | 98.9 |
| | Fluid | 2 | 1.1 |
| HIV Status | Positive | 188 | 100 |
| | Negative | 0 | 0 |
| MBT | Positive | 178 | 94.7 |
| | Negative | 10 | 5.3 |

Table 2. Association between the MTB and demographic data

| Characteristics | | MTB | | X ² -Values | P-values |
|------------------|--------------------|------------|----------|------------------------|----------|
| | | Negative | Positive | | |
| Sex | Female | 102 (97.1] | 3 (2.9) | 2.862 | 0.091 |
| | Male | 76 (91.6) | 7 (8.4) | | |
| Age range | Less than 20 years | 13 (86.7) | 2 (13.3) | 8.335 | 0.139 |
| | 20-29 years | 44 (100) | 0 (0) | | |
| | 30-39 years | 37 (92.5) | 3 (7.5) | | |
| | 40-49 years | 38 (95.0) | 2 (5.0) | | |
| | 50-59 years | 22 (88.0) | 3 (12.0) | | |
| | 60 years & above | 24 (100) | 0 (0) | | |
| Specimen | Sputum | 177 (95.2) | 9 (4.8) | 8.013 | 0.005 |
| | Fluid | 1 (50.0) | 1 (50.0) | | |

Values are presented in frequency and percentage.

There is no significant association ($P=0.091$) between the **MTB** and the sex of the respondents (Table 2).

There is no significant association ($P=0.139$) between the **MTB** and age range of the respondents (Table 2). There is a significant association ($P=0.005$) between the **MTB** and specimen (Table 2).

4. DISCUSSION

According to CDC and WHO recommendations, HIV testing should be provided to those who have been diagnosed with TB disease. HIV is the most significant risk factor for the development of TB among people who have *M. tuberculosis* infection [11]. More than 50% of the time, TB is the initial sign of AIDS in underdeveloped nations and is the most frequent dangerous opportunistic infection among HIV positive people [12].

According to this study, there were 10 [5.3%] *Mycobacterium* TB cases among HIV patients at the federal medical Centre in Asaba, Delta State. According to the WHO in 2010, an HIV positive person infected with *M. tuberculosis* has a 50% lifetime risk of acquiring TB, whereas an HIV negative person infected with *M. tuberculosis* only has a 10% lifetime risk. This prevalence rate was lower than that. Although the introduction of HAART has decreased the rate of secondary infection in HIV/AIDS patients receiving HAART, numerous studies have shown that HAART resistance may exist, placing stress on the host's immune system and opening the door for opportunistic infections [13]. The highest frequency of MTB was seen among HIV patients in the age ranges of 20 to 29 and 50 to 59 years. The prevalence of HIV/AIDS patients tends to rise among these age groups, which may have predisposed them to a high prevalence among the age groups. These age groups are the most active young ages and the older ages. Additionally, the study done by Faesey et al. [14], revealed a significant frequency of MTB among

those between the ages of 18 and 35. The percentage distribution of Mycobacterium tuberculosis infections among HIV patients was shown to differ slightly depending on the sex, with male infections being slightly more common than female infections. Suggesting that men are more prone to contracting TB. However, anyone, male or female, can become infected, particularly if they come into touch with the MTB's aerosol. This was in line with earlier research by Akyala et al. [15], who found that sex does not predispose an immunocompromised host to bacterial infection. According to Tong et al. [16], host risk factors appear to be a significant component in the epidemiology of disease in Africa. According to Allan et al. [17], TB spreads through inhalation and settles in the lungs, where it multiplies. From there, the germs may occasionally travel through the blood to various organs and tissues, including the kidney, joints, and brain. About 10% of the time, the immune system is able to keep the infection in the chest, but at some point, during the infected person's life, the infection manifests as an active TB disease.

5. CONCLUSION

An important correlation between the frequency of TB and HIV patients at the federal medical centre in Asaba, Delta state, has been found. And based on the research, we recommend that persons with HIV, especially those who are younger, be considered when doing any studies to provide them with the fundamental criteria that may be used to access their health and prevent contact with mycobacterium tuberculosis. We also call for a thorough investigation in this area.

ETHICAL APPROVAL AND CONSENT

The ethical clearance for this research was granted by Ethical Committee of Federal Medical Centre Asaba, Delta state after due processes had been followed. Before the collection of the sample, information regarding the study was explained to the subjects. Oral and written consent for participation in the Study was obtained.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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